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JULY 8, 1985

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RATIONAL'S FIVE-YEAR DESIGN EFFORT

PAGE 36

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FULL-SCALE AUTOMATED CHIP MAKING GETS CLOSER/42

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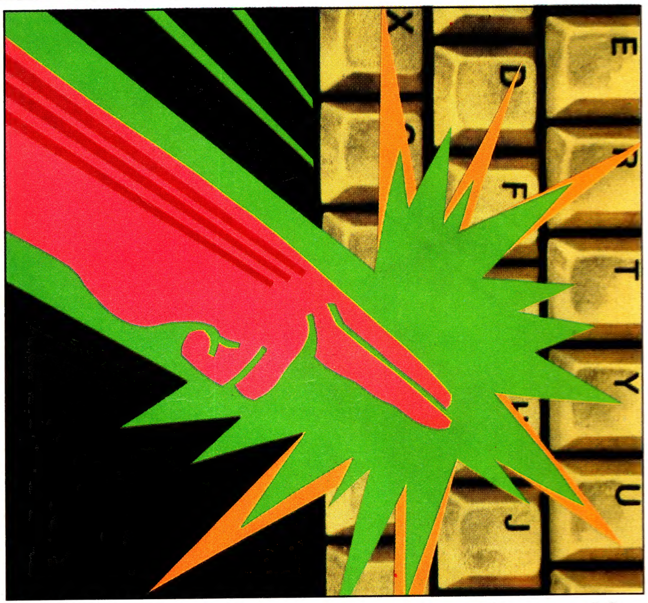
Electronics

TECHNOLOGY TO WATCH



COVER: A speedy new way to write software, 36
Large, complex systems such as real-time aerospace and defense projects call for millions of lines of computer code. Traditional software-development systems have fallen short when faced with the need to create and manage such massive programs. But Rational's new development system, built on the Ada language, can increase the productivity of programmers by orders of magnitude.
Cover illustration by art director Fred J. Sklenar

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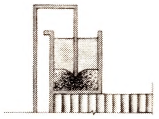
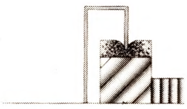


Dual seal



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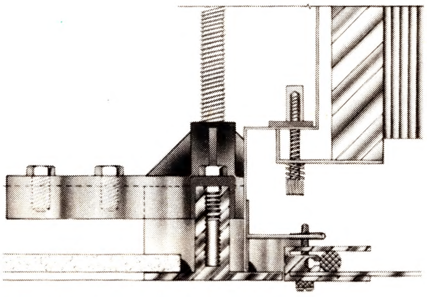

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PUBLISHER'S LETTER

A magazine is more than a conglomeration of articles, stories, and pictures. It is a collection of people—writers, editors, artists, designers—working closely together to create each issue. And a magazine that comes out every week and covers so broad and complex a field as electronics needs that team dynamics more than any other publication. That is why we are so pleased to welcome back to the fold our copy chief, Susan Levi Wallach, shown above.

As supervisor of the copy desk, her responsibility is nothing less than the quality of the writing: she is the arbiter of grammar, spelling, capitalization, punctuation, and all the facets of that ephemeral quantity called style. In effect, she is the one who sees to it that the team stays in step. So when she left in May to take a copy chief job closer to home and her daughter, Sarah, and infant son, Cameron, the editors of *Electronics* felt the loss sorely. But Susan felt the loss just as sorely and wasted no time in letting us know about it. "After my first day away, I knew I wanted to go back," she says. So she has come home and is once again supervising the copy desk, arbitrating disputes, and keeping us all on the right linguistic track.

Although Larry Waller did not have to leave his Los Angeles base, where he's been covering Southern California's aerospace and electronics community for *Electronics* longer than he cares to confess, working on the Hughes Aircraft Co.'s Infra-Red Search and Track system story on p. 21 amounted to a homecoming of another sort. As Larry explains, "I wrote about infrared detection, a gee-whiz technology development, in the mid-1960s when Hughes originally built the first such gear for the Air Force's hottest fighters of that time, the Century Series.

"But what encourages me particularly is that perfectly good avionics equipment is being picked up, outfitted, and flown on National Guard aircraft, instead of going on the surplus heap like so many supposedly outdated things. And IR technology has a lot going for it still, such as a passive nature that electronic countermeasures can't jam. For these and other reasons, it's not beyond possibility that the Air Force might yet opt for advanced systems with IR imaging capability for fighters of the 1990s still on the drawing board. I trust I will be around to do those stories, too."

Laurence Altman

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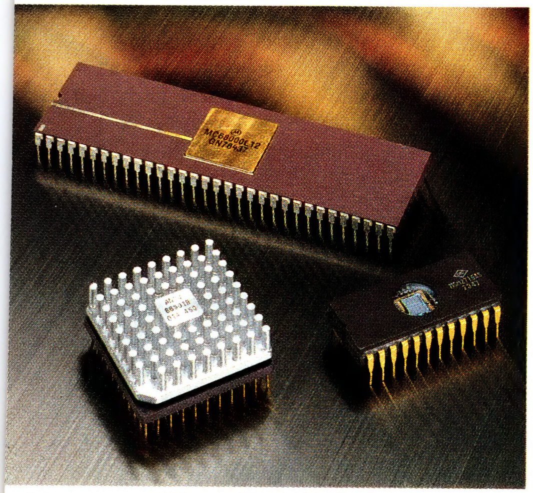
Take a Small Tes

What's the #1 "hidden" cost in manufacturing IC chips?

Testing. In the past, testing chewed up 10 percent – or more – of microchip manufacturing costs. And with technologies such as very-large-scale integration, chip testing is becoming one of the largest – perhaps **the** largest – of recurring expenses.



C'mon, aren't all systems pretty much the same?

Hardly. Test systems run the gamut from benchtop testers for simple inspection to full-blown high-level systems that take care of everything from handling the chips to collecting data. High-end systems – such those built by Ando Electric – are almost a necessity for VLSI and other advanced circuits.

How can I squeeze more out of each test dollar?

The key is the automatic test equipment itself. You want an ATE system that can test accurately, and that can give you the kind of backup documentation you need. Even a tester for R&D should have good cost-performance, too, to keep the per-chip test cost low. Finally, your ATE should be flexible, so you don't have to add a lot of customized hardware every time you change ICs.

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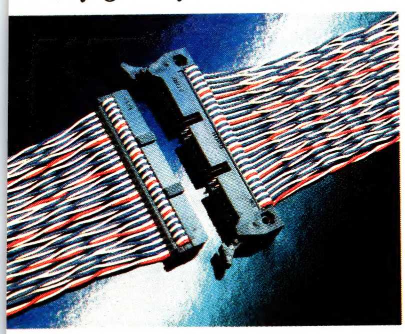
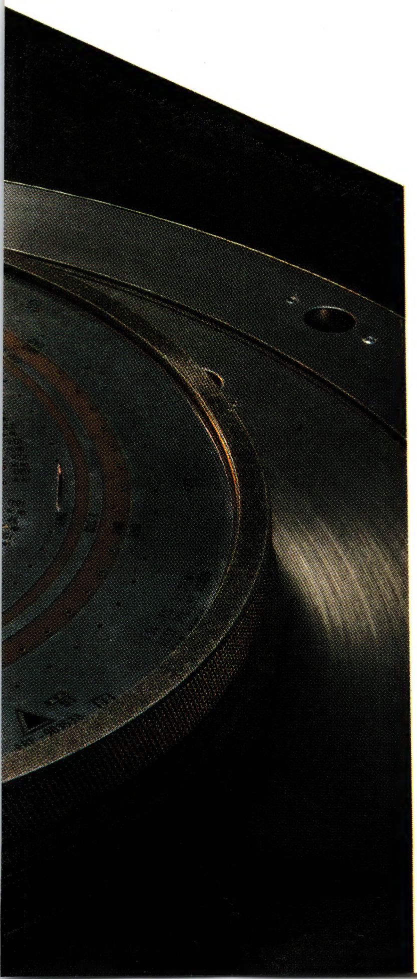
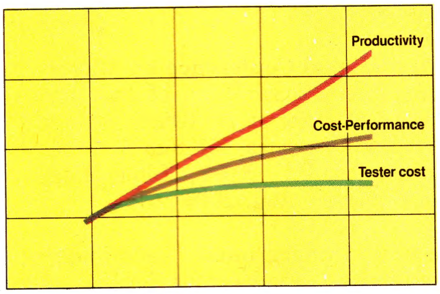




What do you mean by "cost-performance?"

Looking at **overall** results rather than just initial cost. Setup, training, reconfiguration, reliability: they're all part of the equation. Put simply, cost-performance means that the bottom line isn't always visible on the price list.



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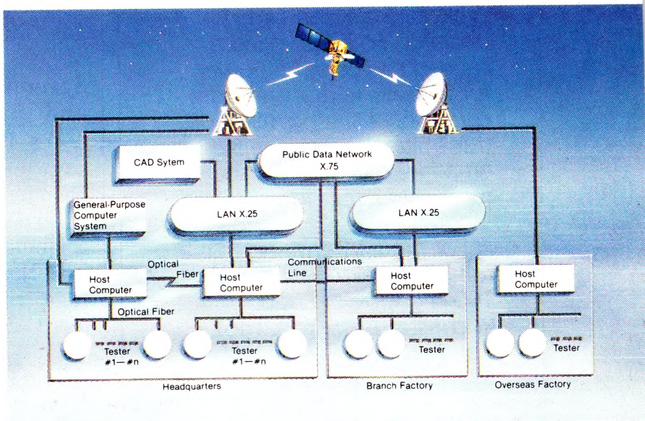

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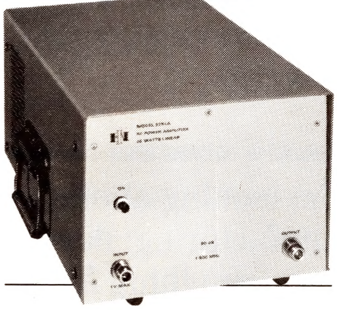

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MEETINGS

Society of Logistics Engineers International Symposium, Society of Logistics Engineers (303 Williams Ave., Suite 922, Huntsville, Ala. 35801-6061), Sheraton Harbor Island East, San Diego, Aug. 18-22.

IJCAL-85, International Joint Conferences on Artificial Intelligence Inc. *et al.* (Steve Crocker, Aerospace Corp., P.O. Box 92957, Los Angeles, Calif. 90009), University of California at Los Angeles, Aug. 18-24.

PC Fab Expo '85 Technical Seminar and Trade Show, *Printed Circuit Fabrication* magazine (Julia Wilson, PC Fab Expo, 1790 Hembree Rd., Alpharetta, Ga. 30201), Park Plaza Hotel, Boston, Aug. 26-28.

Intech '85—Integrated Information Technology Conference and Exposition, National Trade Productions Inc. (2111 Eisenhower Ave., Alexandria, Va. 22314), Moscone Center, San Francisco, Aug. 26-30.

International Conference on Magnetism, International Union of Pure and Applied Physics, *et al.* (Diane Suiters, Courtesy Associates, 655 15th St. N.W., Washington, D.C. 20005), Hilton Hotel, San Francisco, Aug. 26-30.

Second Underground Technology Conference, Engineering Society of Detroit (100 Farnsworth Ave., Detroit, Mich. 48202), Las Vegas Hilton, Las Vegas, Aug. 27-29.

Seventh Quartz Devices Conference and Exhibition, EIA (2001 Eye St. N.W., Washington, D.C. 20006), Westin Crown Center, Kansas City, Aug. 27-29.

Interconnect '85, United States Telecommunications Suppliers Association (333 N. Michigan Ave., Suite 1618, Chicago, Ill. 60601), Expo Center, San Mateo, Calif., Aug. 27-29.

Advanced Manufacturing Techniques in Electronics, Institution of Electronic and Radio Engineers (IERE, 99 Gower St., London WC1E 6AZ, England), University of Edinburgh, Edinburgh, Scotland, Sept. 2-4.

The 11th International Colloquium on Magnetic Films and Surfaces, IEEE (P. E. Wigen, Department of Physics, Ohio State University, 174 W. 18th Ave., Columbus, Ohio 43210), Asilomar State Park, Monterey, Calif., Sept. 2-4.

On-Site Power Show, Electrical Generating Systems Association (EGSA Headquarters, P.O. Box 9257, Coral Springs, Fla. 33065), Hyatt Regency Hotel, Minneapolis, Sept. 4-5.

Third Videotex Congress, Swiss Industries Fair (Congress Secretariat of the Swiss Industries Fair, Messeplatz 22, 4021 Basel, Switzerland), World Trade and Convention Center, Basel, Sept. 5-6.

Adhesives '85, Society of Manufacturing Engineers (1 SME Dr., Dearborn, Mich., 48121), Atlanta Hilton and Towers, Atlanta, Sept. 10-12.

SEMINARS

Software Quality Assurance, Technology Training Corp. (P.O. Box 3608, Torrance, Calif. 90510-3608), Emerald Hotel, Anaheim, Calif., Aug. 19-20.

Workshop on Coupling Symbolic and Numerical Computing in Expert Systems, American Association for Artificial Intelligence (Janusz A. Kowalik, Boeing Computer Services, M/S 7A-03, P.O. Box 24346, Seattle, Wash. 98124), Boeing Computer Services AI Center, Bellevue, Wash., Aug. 27-29.

Silicon Processing for the VLSI Era, University of California Extension (P.O. Box AZ, Irvine, Calif. 92716), Pembroke College, Cambridge University, London, Sept. 9-13.

Engineering and Management Program, University of California at Los Angeles Extension (UCLA Extension, 10995 Le Conte Ave., Los Angeles, Calif. 90024), UCLA, Los Angeles, Sept. 9-14.

Surface Mount Technology Seminar, Worldwide Convention Management Co. (17730 W. Peterson Rd., Libertyville, Ill. 60048-9989), Summit Hotel, Dallas, Sept. 10-11; Hyatt Regency Woodfield, Chicago, Oct. 17-18; Sheraton, Boston, Nov. 19-20; LeBaron Hotel, San Jose, Calif., Dec. 5-6.

VHSIC Applications Workshop, Department of Defense (Palisades Institute for Research Services Inc., 201 Varick St., New York, N.Y. 10014), David Sarnoff Research Center, Princeton, N.J., Sept. 10-12.

Teleconferencing—Technology, Applications, Equipment, and Effective Utilization, Frost & Sullivan Inc. (Carol Every, Frost & Sullivan, 106 Fulton St., New York, N.Y. 10038), Selfridge Hotel, London, Sept. 10-13.

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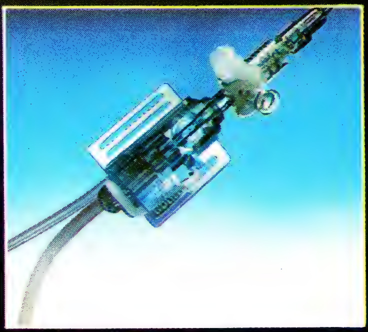

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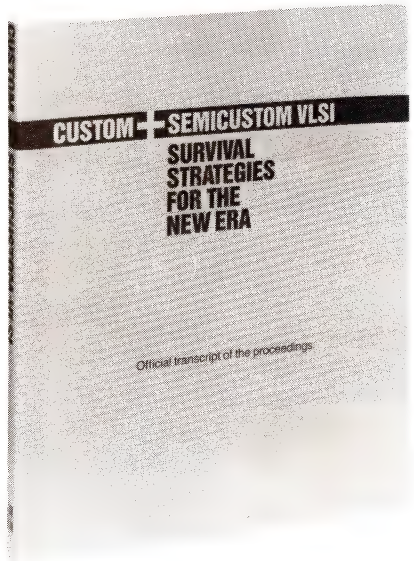
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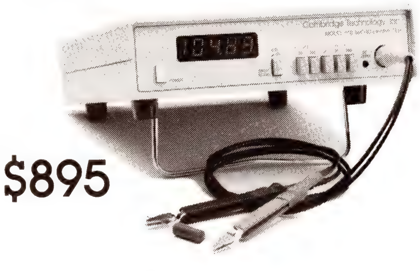

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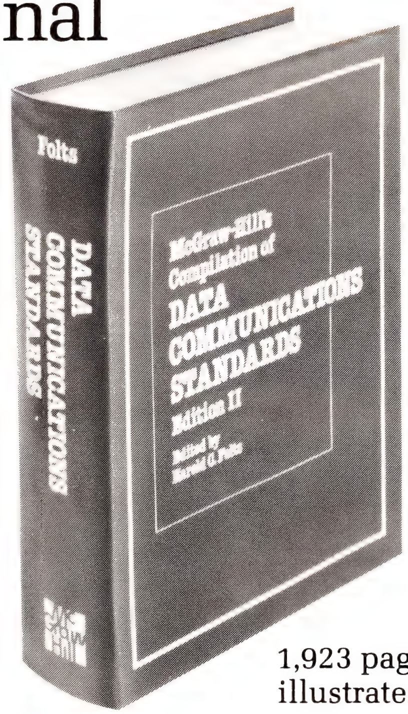
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ELECTRONICS NEWSLETTER

AT&T ENTERS JAPANESE VALUE-ADDED NET MARKET

Seeking a piece of the value-added network (VAN) communications market in Japan, AT&T Co. last week invested $35 million for a 50% share in a venture with a group of Japanese companies led by Hitachi, Fujitsu, Mitsui, and the Industrial Bank of Japan. The venture, which will offer sophisticated systems in Japan for transmitting computer data, should start operations by year-end. AT&T chief executive Charles L. Brown, in Tokyo for the announcement, said the move "affirms what we've been saying—that AT&T intends to be a major participant in the Japanese information movement market." The full array of major players in the Japanese VAN market is still incomplete. IBM Corp. has formed its own VAN venture with a Japanese software house, Cosmos 80. General Electric Co., which is completing final arrangements for a tie-up with NEC Corp, could be next in Japan's VAN market. ☐

INTEL, XICOR AGREE ON JOINT EEPROM PROJECT

Xicor Inc., Milpitas, Calif., considered the technical and business leader in electrically erasable programmable read-only memories, has signed an agreement with Intel Corp. for joint development of advanced EEPROMs. Under the agreement, Intel will put up $10 million for joint research and development over the next two years. In addition, it will help Xicor obtain advanced manufacturing equipment. In return, Intel will receive warrants to buy 1.2 million shares—or about 8%—of Xicor's outstanding stock at $10 a share. The deal also covers mutual second sourcing, giving Xicor a substantial backup for its products. ☐

SONY GETS 256-K CMOS DRAM TECHNOLOGY FROM VITELIC

Under an agreement with Vitelic Corp., Sony Corp. will get 256-K CMOS dynamic-random-access-memory technology from the San Jose, Calif., company. Sony will do front-end processing; Vitelic will handle assembly, testing, and sales. By year-end, Sony expects to have a new line in operation at its wholly owned subsidiary, Sony Kokubu Semiconductor Corp., in Kokubu, Japan. A spokesman says Sony signed the agreement to learn how to produce DRAMs, a product with which it has no experience. The spokesman would not elaborate further. But observers in Japan think Sony needs the technology for use in digital TVs and video cassette recorders. ☐

INMOS SHAKEUP FOLLOWS BOARD REVOLT

Change is on the way for Inmos plc, following a boardroom shakeup at its troubled parent, Thorn EMI plc. Peter Laister last week resigned as chairman and chief executive of the $3.66 billion group; deputy chairman Sir Graham Wilkins replaced him. Problems with Thorn EMI's consumer and chip-making operations could cut into the firm's soon-to-be-announced year-end profits. For the first six months, the company's profits were down 28% over the same period last year.

At Inmos, problems caused by the industry-wide recession have been compounded by production snags at its U.S. plant, which reportedly has cut production of Inmos' fast static random-access memories by one third and delayed the introduction of new parts. Two months ago, Douglas Stevenson was put in charge to sort out the company. Now Inmos cofounder and deputy chairman Richard Petritz and chief operating officer John Heightley "have been relieved of their executive duties," Inmos said. Further changes are promised. Inmos is pulling out of the dynamic-RAM market and has given top priority to proprietary products—in particular, variants of the Inmos transputer. ☐

ELECTRONICS NEWSLETTER

HYPERCHANNEL FIRM TO INSTALL 275-Mb/s COMMUNICATIONS MEDIUM

Already the leader in high-speed host-to-host networking systems with its 50-Mb/s Hyperchannel, Network Systems Corp., Minneapolis, plans its first installation in September (about six months behind schedule) of Datapipe, a fiber-optic backbone said to run at a blazing 275 Mb/s. Designed for customers who need to link thousands of processors built by different vendors in diverse locations, Datapipe will tie together multiple Hyperchannel networks as well as 10-Mb/s Hyperbus local nets. The system will also bring in voice and video communications, including telecommunications, facsimile, teleconferencing, and security in what Network Systems calls a "global network," linked by satellite or high-speed phone lines. The company says Datapipe-based networks could one day link up to 20,000 processors ranging in performance from supercomputers to micros. Network Systems is working on network-management system software to keep track of it all. A second test installation at a customer site is planned for December. ☐

BRIDGE COMMUNICATIONS TO OFFER PENTAGON PROTOCOLS

Yet another implementation of the U.S. Defense Department's transmission control and internet protocols (TCP/IP) is available for users who can't wait for the International Organization for Standardization networking protocols to reach the product stage [*ElectronicsWeek,* May 13, 1985, p. 34]. Bridge Communications Inc., Mountain View, Calif., will demonstrate Ethernet servers and internetwork gateways incorporating TCP/IP at the National Computer Conference in Chicago next week. "The ISO protocols will become an industry standard, but as yet there is no complete commercial implementation," said Bridge president William N. Carrico. Bridge's family includes a gateway between two remote Ethernets, a link between IBM Corp. Systems Network Architecture hosts and TCP/IP-based hosts, and a terminal server for TCP/IP-based Ethernets. ☐

EC COUNTRIES BACK FRANCE'S EUREKA PROJECT

Heads of state of the European Community countries voiced their support for the French-proposed Eureka scheme, a high-technology research project conceived as an alternative to the U.S. Strategic Defense Initiative. At the EC summit that ended in Milan on June 30, the 12 leaders agreed to send their research and science ministers to an ad hoc committee meeting to be held in Paris next week to map out finance plans for the program as well as to define an administrative structure. In addition to the EC countries, representatives from Austria, Sweden, Norway, and Switzerland are expected. ☐

AT&T-PHILIPS TELECOMMUNICATIONS IN FRENCH MARKETING TALKS

The French nationalized Compagnie Générale d'Electricité (CGE) and AT&T-Philips Telecommunications are negotiating a two-pronged market-exchange and product-development agreement, according to French industry and government sources. If successful, the accord would open an as-yet-undetermined portion of the French market to the AT&T-Philips joint venture in exchange for U.S. orders for switches from Alcatel-Thomson. Alcatel-Thomson is the French switch maker controlled by the CGE and formed by the merger of the public-switching segment of CIT-Alcatel and the Thomson Telecommunications subsidiary of Thomson-CSF. Alcatel-Thomson and AT&T-Philips would also cooperate on future new product developments. The deal would open the first substantial European market for the AT&T-Philips venture while giving CGE a much-needed boost in export markets in general, and the U.S. market in particular. ☐

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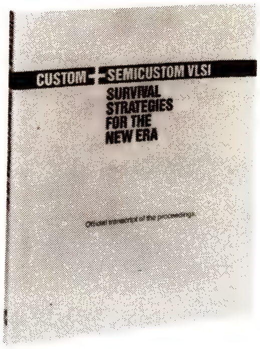
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THIS Electronics WEEK

THURSDAY *June 27*

Hughes Aircraft Co. said it has developed **an artificial-intelligence-based computer system that automatically translates complex engineering-design requirements into step-by-step instructions** for assembly workers. Hughes said that AI analyzes the product-design data and displays it on color terminals at computer work stations on the factory floor. Hughes' Electro-Optical and Data Systems Group's plant uses the system to manufacture printed-circuit boards.

FRIDAY *June 28*

As thousands of assembly workers in sunny Silicon Valley prepared for one or two weeks of forced vacation, a small electronics firm in New York's blighted South Bronx unveiled its latest product. Protocom Devices Inc. introduced a protocol implementation of its packet assembler/disassembler called the P2500 **that will allow IBM Corp. 3270 terminals to access X.25 packet-switched networks.** The $6,000 machine, which supports up to 40 terminals, is the two-year-old company's first product aimed at the competitive IBM market. Previously, Protocom implemented the P250 on Sperry Corp. and Burroughs Corp. equipment [*ElectronicsWeek,* April 22, 1985, p. 33].

MONDAY *July 1*

Although observers might have thought its name would have been enough to ward off most potential suitors, **Garlic Technology Corp. became Eastman Kodak Co.'s third acquisition in as many months** when the photography giant announced today that it had acquired most of Garlic's assets for an undisclosed sum. Furthering Kodak's recent push into the high-technology arena [*Electronics,* July 1, 1985, p. 50], Garlic, which specializes in the design and development of advanced digital magnetic recording heads, complements Kodak's Spin Physics unit, which also specializes in magnetic recording. The Morgan Hill, Calif., company will operate as a subsidiary, reporting to Kodak's Rochester, N.Y., Mass Memory Products Division. . . . Laser '85 opened its doors for a five-day run in Munich today amid predictions that the West's **civilian laser market will increase nearly 30% a year during the next few years,** up from a total business volume of $4.4 billion in 1984. Show officials say that lasers and laser-based equipment for communication systems, recorders, laser printers, copying equipment, and point-of-sale systems represent the industry's fastest-growing segment.

TUESDAY *July 2*

Continuing a trend begun earlier this spring when Lotus Development Corp. took over Software Arts Inc., **Software Publishing Corp. today said it agreed to acquire Harvard Software Inc. for an undisclosed amount.** Harvard, of Littleton, Mass., makes Project Manager and Total Project Manager, a pair of PC-DOS programs that can transfer data to and from programs such as Lotus 1-2-3 and Symphony. SPC, in Mountain View, Calif., says the market for management-software programs is small but growing and that Harvard has been a leader in developing such packages.

WEDNESDAY *July 3*

The Scottish Development Agency, charged with attracting new business, released the results of a two-year study today. It predicted that **sales of information systems in Europe will grow at a 15% rate over the next decade,** compared with a 10% growth rate in the U.S. market. □

Electronics

DESIGN-DATA FORMAT STANDARD FLIES INTO FLAK

Computer-aided-engineering users fault work-station makers on lag in implementation

Las Vegas

Nearly 200 users of computer-aided-engineering tools stayed an extra day after the late-June Design Automation Conference to check on the current status of the proposed industry *lingua franca,* the Electronic Design Interchange Format (EDIF). The rapidly developing standard ran into criticism from company representatives who complained that work-station vendors sponsoring the standard were thwarting its basic purpose by refusing to implement proprietary design libraries in it.

EDIF is, or will be, a nonexecutable interface language that allows integrated- or printed-circuit design data developed on one system to be read on equipment that uses an incompatible data format [*ElectronicsWeek,* Dec. 3, 1984, p. 68]. Designers have long seen such a common representation linking different data formats as a necessity. Without it, they must spend considerable time and energy writing multiple interfaces for each new standard cell or gate array to avoid restricting customers to a particular set of CAE gear.

Private standard. EDIF is a private standard, much like the Enhanced Small Disk Interface being constructed by makers of 5¼-in. Winchester drives and controllers. EIDF was launched 15 months ago by a consortium of six semiconductor and design-automation firms; it has been nurtured by a steering and a technical committee dominated by sponsors Motorola, National Semiconductor, Daisy Systems, Mentor Graphics, Tektronix, and Texas Instruments.

Motorola presented the majority of the 11 technical papers delivered at the Las Vegas meeting, which was billed as the first one for users. Most of the papers described early efforts to find common constructs and map them into EDIF, or how to build parsers and write EDIF programs in various languages.

Some new users present noted that none of the papers described how to transmit design data between dissimilar systems, which is EDIF's goal. By this fall, however, TI and National expect to be using the interface to transmit information relating to their 32000-series second-sourcing agreement, using a system based on the version 1.0 EDIF specification released last March.

The interface will have a version 1.X by midsummer and a fully revised version 2.0 by the first quarter of 1986. "I would hope that within a year it will be regularly used," said users' group president Paul Stanford of TI.

Some attendees thought the turnkey houses—Daisy, Mentor, Tektronix—are being disingenuous in pushing EDIF when they will not provide EDIF interfaces to their proprietary libraries. "We don't see anything close to an industry standard," said Terry Zimmerman, marketing vice president for Futurenet Corp., Los Angeles. "We keep hearing about open architecture and an open data base, but it's an illusion."

Turnkey vendors resist offering proprietary design libraries in EDIF

Personal CAD Systems Inc., of Los Gatos, Calif., like Futurenet, a provider of CAE systems based on IBM Corp. Personal Computers, is also skeptical about EDIF and chose the DAC to introduce its own version of a design interface, called PDIF. "We were pressured into it," claimed president Richard Nedbal. "Our big accounts want to move around to different data bases."

One of those accounts is TI, which Nedbal said asked PCAD to develop PDIF. "We'll throw it out when EDIF is accepted as a standard."

The standard's backers respond to this heckling by pointing out that EDIF is supposed to be a voluntary interface, not a key to proprietary software. "We want to create a language so that people can talk where there is a desire to talk," insisted Stanford. "We don't want different dialects, but there's no way this can be anything but a voluntary process."

Steve Schmidt of Mentor and John Eurich of Daisy acknowledged that their companies' parts libraries would proba-

Backing EDIF. Steve Schmidt of Mentor Graphics tells CAE users that his firm stands strongly behind EDIF, even though Mentor's parts library probably will not be available in the format.

GENERIC CELLS DECLARE FOUNDRY INDEPENDENCE

Two Silicon Valley firms have introduced generic-cell libraries, giving designers the same independence from foundries as that the Electronic Design Interchange Format provides from work-station and computer-aided-engineering software vendors.

"We have had a number of customers who have been burned" by committing to one foundry, says Peter Salmon, vice president of business development for Source III Inc., San Jose. Both Source III and R. C. Anderson Inc., Los Altos, have developed cell libraries compatible with several foundries producing CMOS semiconductors.

VLSI Design Associates, San Jose, developed the Multicell design library that Anderson markets. The library contains 90 cells, including random-access and read-only memories, programmable logic arrays, the equivalents of small- and medium-scale logic integrated ciruits, and on-chip and stepped-in test cells. It is combined with the Multisource C2 design system developed by Anderson, which identifies participating foundries' common design parameters for multiple sourcing.

Three participating foundries—Gould AMI, International Microelectronic Products, and Zymos—guarantee that the Anderson system is compatible with their process technologies. Anderson expects the program to double soon.

The generic-cell library format is less efficient than one tailored to a specific foundry process, so the resulting circuit will be slower. But thanks to the similarity between the various foundry design parameters for 3-μm CMOS, Anderson says the speed loss is less than 10%.

The Anderson system runs on Mentor Graphics, Digital Equipment Corp. VAX, and Calma work stations, and the company will install it on other major systems upon request. The cell library and design-rule system will sell for about $28,500; delivery takes 30 days.

Source III's library is called Genlib 3000. Salmon says it is based on the design rules that the company compiled after years of working with different foundries. "We closed the loop by going back to the foundries and having them look at our rules."

He points out that though the Spice simulation of circuits designed with the generic rules show 5% to 20% less speed compared with those designed to a foundry's rules, the comparison of actual fabricated parts show only a 5% to 10% speed tradeoff.

The Genlib system is currently compatible with five foundries—Gould AMI, International Microelectronic Products, Comdial Technology, NCR, and VLSI Technology. Salmon expects the number to increase to 8 or 10 foundries by year's end, but believes that even now "essentially we've established foundry independence" from a practical point of view.

Source III's Genlib system contains over 56 components in its library and is scheduled to be delivered by the end of July on three types of work stations: Valid Logic, Via Systems, and CAE Systems/Tektronix. The company offers four levels of customer support, ranging in price from $5,000 for a basic system and consulting services up to $30,000 for a complete turnkey design. **–Eve Bennett**

bly not be available in EDIF, and doubted that the other turnkey companies would provide theirs. Although many customers have more than one type of work station and would like to move designs among them, Schmidt said, that might not always be possible without giving away proprietary information.

One user suggested that encryption might provide a possible compromise solution; but in general the issue of proprietary software was treated as a business matter that was somewhat out of place at a mostly technical meeting.

One technical matter that the EDIF group will tackle soon is the question of where to take its emerging standard in search of official backing. The EDIF steering committee will meet late this month in San Mateo, Calif., to discuss whether the Institute of Electrical and Electronics Engineers, the American National Standards Institute, or the International Organization for Standardization is the appropriate forum.

Standards bodies. The issue is not merely academic. An ISO technical committee is already considering a rival standard called IGES (for Initial Graphics Exchange Specification), and will submit it to an ANSI subcommittee. IGES was developed for physical board layout but is developing an electronic component. It has support within the National Bureau of Standards.

"We intend to align with one of the existing standards organizations," said steering-committeeman Henry Alward of Tektronix. "When we enter that formal process, we're inviting the world in—that may slow us down."

In the meantime, Schmidt will prepare a survey to check on users' are with the implementation of the EDIF standard that was released last March. Results of the survey will be presented at the next users' meeting during the IC-CAD conference, which will be held in San Jose, Calif., in November. *–Clifford Barney*

BUSINESS

PAUSE IN PRODUCT INTROS TAKES EDGE OFF NCC

Los Angeles

Because a steady flow of new products from laboratory to user provides an industry's lifeblood, any slowing down quickly captures attention. At midyear, signs of a such a pause in the computer-product introduction cycle are beginning to appear.

One tipoff is in the plans of the companies exhibiting at next week's National Computer Conference in Chicago, a gathering that historically is a major showcase for new wares. Not only is the exhibitor total down to about 600, the lowest in years, but those attending have cranked back their introductions, to judge from a check of representative firms. NCC officials say that 40% of them will highlight new products, but even this figure hints at a drop: in the past, more than half the vendors brought out new offerings at the show.

Slowing product activity during a period of soft demand does not surprise veteran marketing people, who often see these cycles come and go. Says one such official at a leading West Coast peripherals firm, "It doesn't make any sense right now, with the pipelines so clogged with products few are buying. Maybe later as business gets better." He declines identification, a typical stance for a subject considered too negative for attribution.

Vendors of engineering work stations, however, say they have not felt the effects of the slowdown. At the Design Automation Conference held in Las Vegas during late June, some 50 of the 80 exhibiting firms had new products to show, and many more than one.

Another factor is dampening microcomputer product development, notes consultant Will Strauss of Forward Concepts Inc., Scottsdale, Ariz. "In the systems world, everyone is waiting for IBM to come out with its PC-2. Nobody wants to guess and develop products and be wrong. That would wipe them out." Instead, developments go on hold; with industry reports saying that the PC-2 will not surface until late this year (IBM, as usual, is not talking), the wait could stretch well into 1986, says Strauss.

No-shows. Beyond any downswing in product hoopla during a slow year, show officials should recognize another trend that could snowball: some of the largest firms are evaluating whether these events are useful to them under any circumstance. Among the no-shows next week will be Digital Equipment Corp., Perkin-Elmer, and Harris Computer Systems Division; Control Data, Burroughs, and Zenith Data Systems all have reduced their presence.

The dropouts cite both congested NCC show conditions that make selling difficult and the kinds of people that attend. "It's difficult to show someone in 10 to 15 minutes going through a crowded booth everything this company can do," says a DEC representative. For Harris Computer Systems' part, the emphasis on microcomputer-based low-end gear dilutes its target market. Perkin-Elmer plans to bring out products in coming months at its own events, as will DEC.

Big-system vendors question value of broadly based shows

CDC's Peripheral Products Co. has steadily cut the number of products it unveils at NCC from seven in 1983 to only one this year—an 8-in. 368-megabyte disk drive. The reduction is CDC's way of avoiding "getting lost in the shuffle" at the show, says a spokesman.

Few computer makers have NCC introductions in the works, although last-minute changes in plans are common. Among those in the offing are a high-end machine from Encore Computer Corp. and a Pyramid Technology Corp. system more powerful than its 90x.

Most observers see no harm in a product-activity slackening as long as demand also lags. As James Porter, a consultant and editor of "Disk/Trend Report," puts it, "It can't be new, new, new all the time. The technology won't support it." But all emphasize that companies must keep up steam in developing improvements to bring out when business does turn up. There is no sign that firms have backed off on this score, most sources say. *–Larry Waller*

COMPUTERS

ENCORE EYES MULTIPROCESSOR MARKET

Wellesley, Mass.

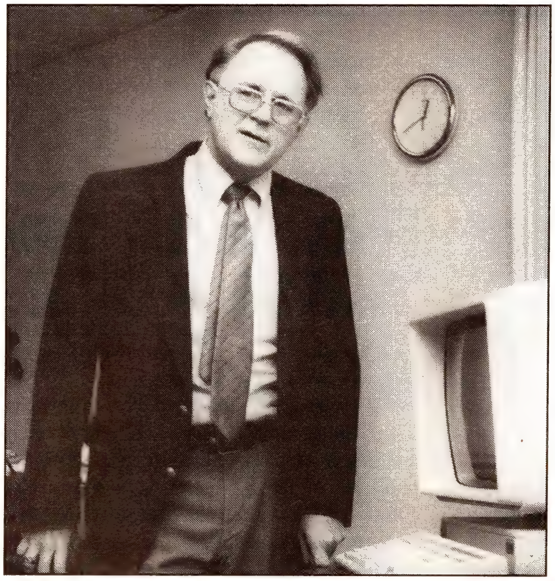
As they prowl the vast halls of Chicago's McCormick Place during the National Computer Conference next week, mips mavens should linger at the demonstration of Encore Computer Corp. The Wellesley firm should have its Multimax machine—a multiple-processor computer that can execute up to 15 million instructions per second—up and running on the stand of National Semiconductor Corp., supplier of the machine's 32-bit microprocessor chips.

The machine represents the first move in Encore's drive to move multiple-processor machines out of the laboratory and into the commercial mainstream. Multimax offers the flexibility of using up to 10 microprocessors and the ability to do parallel processing—all the while appearing to the operator to be as simple to use as a single-processor machine.

"Programmers will love it," says Gordon Bell, Encore's vice chairman. "They won't know the difference—only their programs will run faster and so will their conventional job loads."

Processor independent. What's more, Bell and other company officials point out, the Multimax is largely independent of the type of microprocessor used in it. As a result, it will be possible to upgrade in the future to more advanced processors simply by replacing cards.

Initially, Multimax computers will use a pair of National Semiconductor 32032 microprocessors on each card and accommodate up to 10 cards. The computers have capacity for up to eight 4-megabyte shared-memory cards and use intelligent input/output controllers (which have 32032 microprocessors of their own) in combination Ethernet/mass-storage cards that have 1.5-megabyte/s disk or tape channels.



High on his machine. Encore's Gordon Bell is convinced programmers will love the Multimax machine.

The heart of the Multimax—and of future computers from Encore as well—is its 100-megabyte/s bus. Dubbed the Nanobus because its length approximately equals the distance light travels in a nanosecond, it has a 64-bit data path, a 32-bit address space, and a 14-line vector control. The bus will sustain 500,000 interrupts/s.

"This bus is not necessary for this computer," says Julius Marcus, vice president of marketing. "But we intend to do much more with it."

If the bus is Multimax's heart, the soul of the machine lies with the Encore-developed operating systems. The company chose to develop special versions of Berkeley 4.2 Unix and AT&T System V variations, called Umax 4.2 and Umax V, respectively. These two systems, say Encore officials, exploit multiple processors yet allow programming without intensive data partitioning or massaging.

It was necessary to redesign data structures and logic to allow for multithreading, explains Tony Anzelmo, manager of operating-system development for the multiprocessor division. Crucial in this is the executive, which does real-time scheduling so that the highest-priority, ready-to-run threads (processes) are run first. The system allows for multithreading unless two threads seek to work on the same data, in which case locks are used.

In addition, a "readers and writers" feature ensures that so-called writers—threads seeking to modify the same data—queue up, but that all readers—threads seeking only to read data—get access simultaneously.

Encore claims nearly linear performance increases as processors are added to the Multimax. The locks are particularly important in maintaining the performance curve, according to Rich Billig, vice president of marketing in the multiprocessing-system division.

Many locks are necessary to build a system that will scale to many processors, Billig says, but those locks must also be fast and avoid overloading the system. Multimax's locks can be implemented in any memory location. It takes approximately 500 ns to set a lock, he says.

As a further reduction of system overhead, the user program can directly manipulate the locks, eliminating the need for a mode switch, adds Anzelmo.

To the software, the distributed cache is totally transparent, he says. “I don't know anything about cache. It's just memory.” He also says that the entire system presents itself as any other Unix system would. “The 300 utilities of Berkeley 4.2 all run on Umax, and we didn't do anything to them.”

When the machine is fired up, all processor cards pass two levels of self-checking: they perform a self-diagnosis and also ensure their ability to cooperate in the system. During operation, Multimax can disable problem boards and reconfigure on the fly, says Billig. The system can be configured so that any number of processors work on a single problem.

Essential difference. Encore officials are emphatic about distinguishing the Multimax from other machines incorporating more than one processor. They say the essential difference is that although the Multimax will incorporate up to 10 microprocessors, its memory is completely shared and it uses just one copy of the operating system. In Encore's view, this makes its machine a multiprocessor.

On the other hand, a multicomputer in effect squeezes several computers into one box, each with its own memory. This can create enormous complications in general computing for end users. And Encore emphasizes the Multimax's utility for general computing purposes.

Encore expects that the Multimax computer will soon achieve 40 mips, based on microprocessor improvements, and that very large-scale integrated circuits on the board will increase its power to 80 mips as more processors are added.

Multimax prices will start in the $100,000 to $125,000 range, says Marcus, with deliveries before the end of the year. Although the machine will be demonstrated at the NCC (see related story, p. 17), its formal announcement will not come until early fall at the Federal Computer Conference. *–Craig D. Rose*

SEMICONDUCTOR MATERIALS

FOOL'S GOLD GLITTERS AS SOLAR-CELL MATERIAL

West Berlin

Fool's gold, or pyrite, has caught the eye of researchers at the Hahn-Meitner Institute for Nuclear Research, who have found this iron-sulfur compound is a low-cost alternative to silicon. At the institute's radiation-chemistry department, a five-man research team has obtained “surprisingly good results” with pyrite as a photovoltaic material for mass production.

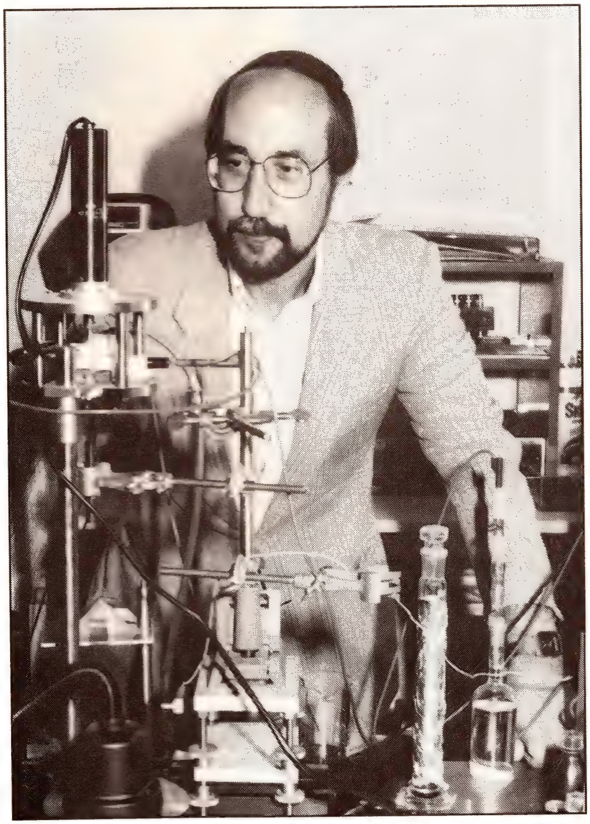
Silicon is still the mainstay of the semiconductor industry, but researchers everywhere are looking for materials less costly to produce. Though the quartz sand from which pure silicon is made is abundant, turning it into monocrystalline silicon for solar cells and other solid-state parts calls for energy-intensive techniques.

Pyrite is a photoactive compound known as fool's gold because of its resemblance at first glance to the precious metal. Some of its characteristics are better than silicon's, points out Helmut Tributsch, head of the department. His organization is said to be the only one in the world examining pyrite for solar cells and other applications.

Unlike man-made photoactive compounds such as gallium arsenide, indium phosphide, cadmium sulfide, and cadmium telluride, which are based on materials in short supply, pyrite won't impose limitations on solar-cell production. The known pyrite reserves are estimated to be 1 billion tons. Pyrite also has ecological advantages because it exists in nature and is nontoxic. Cadmium-based compounds, for example, are toxic.

The Hahn-Meitner team has also discovered that pyrite's photovoltaic properties allow it to absorb all visible light in an extremely thin surface layer only 160 Å deep. This absorption is 10 times higher than with thin-film solar cells made from amorphous silicon and 100 to 1,000 times higher than with monocrystalline silicon cells.

Space advantage. It should thus be possible to make large pyrite cells of such flexibility that they can be handled as easily as plastic film, says Tributsch. The thin absorption layer also means the cells weigh less. That advantage makes pyrite versions of solar cells especially well suited to applications in space.



Pyrite may pan out. Helmut Tributsch of the Hahn-Meitner Institute says pyrite offers some advantages over silicon.

Another advantage of pyrite is that it doesn't have to be as pure as silicon. Impurities in pyrite solar cells impede the photovoltaic conversion less than they do in silicon types. For semiconductor-grade silicon, impurities should not exceed a concentration of 10^{15} particles per cm^3. For pyrite, however, the level may be from 10^{19} to 10^{20} particles per cm^3. Pyrite still works with this high level of impurities because the charge carriers encounter relatively few impurity atoms in a light-absorbing layer as thin as 160 Å.

For all pyrite's excellent properties, the Berlin researchers have no illusions that practical solar cells made of the material are just around the corner. “It will take a decade or so before it will find such application,” Tributsch warns. “But pyrite is so interesting that further development is justified.”

Though a pyrite cell's quantum efficiency is about 90%—the same as silicon's—the low photovoltage is a problem. Now it checks in at 0.28 V. But using a reduced impurity concentration and an optimized iron-sulfur mix, Tributsch and his team should be able to get the voltage closer to the pyrite's theoretical limit of 0.5 V. Silicon solar cells sport photovoltages of approximately 0.6 V.

Improvements are also expected in the conversion efficiency of pyrite cells. The team has obtained about 1%—a fair record, given that only a few man-years have been invested in pyrite research. The team is optimistic about eventually getting better than 10%. The energy gap for pyrite is 0.9 eV, which compares with 1.1 eV for silicon.

Pyrite could supplant silicon in solar cells

The team's earlier work with ruthenium disulfide used for investigations into photoelectrolysis aroused its interest in pyrite's possibilities. Although completely different materials, pyrite and ruthenium disulfide are similar in structure and sensitive to light. This led the team to take a closer look at the iron-sulfur compound as an inexpensive alternative to standard semiconductor materials. Ironically, radio manufacturers in the 1930s used pyrite for rectifiers. But they soon discarded it when better rectifier materials came along.

The team's early work was with natural pyrite. But for further investigations, the researchers are producing pyrite in the lab. Synthetic pyrite has a higher crystallinity and a lower impurity concentration than the natural type. It therefore exhibits better photoeffects.

The pyrite is synthesized in a quartz ampoule, in a process based on sulfur vapor and powdered iron. After synthesis, the pyrite material is crystallized using bromine as the transport agent. It reacts with hot pyrite at one end of a reactor to form a gaseous compound. At the other—cold—end, the compound crystallizes and the bromine separates out. The resulting crystals are several millimeters thick. *–John Gosch*

MEMORIES

OPTICAL-ROM CARDS BID FOR BROADER MARKET

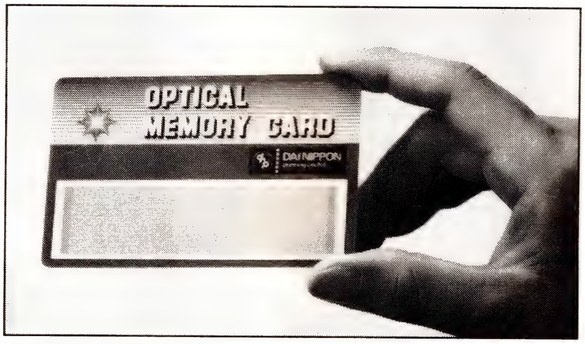
Tokyo

Memory cards the size of credit cards, until now used mainly for electronic banking, are finding their way into other markets. In Japan, Dai Nippon Printing Co. has developed an optical read-only-memory card that it expects will find uses in both text and computer programs as well as in educational materials, personal computer software, automotive navigation data, and recipes.

The card stores 422-K bytes of information in a 78-by-22-mm area on the the card's face. It is scheduled to go on sale at the end of this year.

Dai Nippon, a Tokyo manufacturer of conventional credit cards, says that the initial cost of the card itself (but not the data) will be about $1. The company is working with several electronics manufacturers to develop readers using charge-coupled devices for the cards.

By contrast, the cards developed by Mitsubishi Plastics Industries Ltd. [*Electronics Week*, June 3, 1985, p. 16] and similar cards developed by Mitsubishi Electric Corp. do not need readers. This makes them easier to use for video games, where they effectively take the place of game cartridges.



Light memories. The same size as a credit card, Dai Nippon's optical-memory card will find use in diverse consumer markets.

For many other applications, however, users will find Dai Nippon's optical ROM easier to handle because it does not have to be plugged into a socket.

Dai Nippon fabricates the cards on a 0.40-mm-thick protective polycarbonate cover layer, which forms the front of the card. Then, an acrylic resin photosensitive layer 3 μm deep is coated on the inner surface of the layer and the 5-μm design-rule optical pattern is exposed using a photomask.

Optical ROM may find a wider range of uses

The card is next developed in a nonsilver metallic salt solution that creates the nonreflective black rectangles that represent information bits. Then a 0.1-μm-thick reflecting layer of aluminum is vapor deposited on the pattern.

To complete the card, a 0.35-mm backing layer is laminated onto the protective layer's rear surface. The resulting pattern of rectangular bars has a reflectivity of 5% for the bars and 80% for the spaces between them—giving a 35-dB signal-to-noise ratio. Individual bars measure 5 by 15 μm and are spaced 5 μm from their nearest neighbors horizontally and 10 μm vertically.

A researcher at Dai Nippon's Central Research Laboratory says that patterns of 2 μm and even finer can be made, but that they may not be practical because the cards undergo rough treatment. Also, compared with optical disks that have higher information densities, a relatively thinner cover layer degrades the resolution because dust or scratches on the surface are closer to the sensor lens's plane of focus.

The information is read when a block of data (there are 29 such blocks in each of the card's 28 horizontal rows) has its image focused onto a CCD linear array with 1,024 or 2,048 photosensors, so that the pitch of each rectangle spans four to eight sensors. An even or odd bit in adjacent columns makes it easier to distinguish between signals of adjacent columns as the data is shifted horizontally out of the CCD.

U.S. approach. Drexler Technology Corp. uses a comparable approach. The Mountain View, Calif., company has worked on a similar card for the past four years and expects to bring a product to market by early 1986. Drexler's offering will consist of a ROM card similar to Dai Nippon's as well as a read/write card, according to representative Johanna Protsik.

Both types will have a memory capacity of 2 megabytes. Applications for the ROM card will be the same as for Dai Nippon's. The read/write cards, however, will find most use where information has to be continually updated, such as medical records and financial exchanges.

Licensees for Drexler's products include such giants as Matsushita Electric Industrial Co., Wang, and Hewlett-Packard, among others. All cards will cost about $1.50 each in original-equipment-manufacturer quantities.

In Protsik's view, the half megabyte of user-accessable memory offered by Dai Nippon is "adequate to store video games, but greater capacity is better for something like a medical text with illustrations. In fact, some of our customers have been asking for more than 2 megabytes." *–Charles L. Cohen*

MILITARY

HUGHES RESURRECTS IR DETECTORS

El Segundo, Calif.

A move is afoot to bring the infrared search and track unit back from the grave. The Air National Guard needs to upgrade the old radars on its workhorse F-4 Phantoms to make them more effective against ground clutter as well as electronic-warfare countermeasures, and Hughes Aircraft Co. thinks the answer is in proven IR systems.

The company has proposed transplanting about 180 of these units, known as IRSTs, from deactivated F-106 fighters into the F-4s. The Air National Guard has already installed an IRST in an F-4, and flight tests started in late June.

The recycling idea sprang from discussions last year between Hughes engineers and Air Force logistics brass. Neither group wanted an up-to-date IR capability for air defense phased out and consigned to surplus.

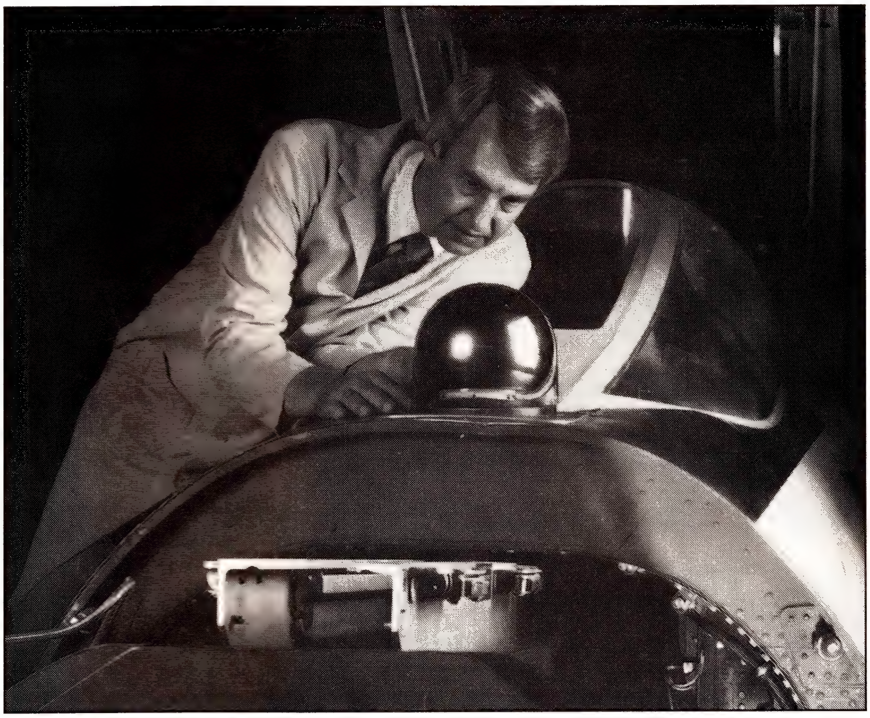
Since the 1960s, IR detectors have had their ups and downs as valued avionics links on U.S. Air Force interceptors. Initially, the units proved themselves by plugging the low-altitude coverage gap—caused by antenna side-lobe clutter—that plagued the radars of that era. Century Series fighters (F-101, F-102, F-106) then used the Hughes passive IRST until high-performance Doppler radars supplanted it. Current Air Force interceptors do not use IR.

Economics cited. "Transplanting it makes a lot of sense because the Air National Guard has a major role in defense of the U.S.," explains Charles J. Steigleder, associate manager of avionic improvement programs at Hughes Radar Systems Group. "The economics are apparent. There is no development needed, inventory and depot support is already there. Why not save it?"

Hughes built some 2,000 of these systems in 10 years and continually cranked in improvements. The most recent and important upgrade was in 1980, when the company replaced its unreliable liquid-nitrogen cooling system with solid-state thermoelectric cooling. (The detector material, lead selenide, needs to be cooled to work best in its 3- to 5-μm operating-frequency range.)

Steigleder extolls the reliability that has been gained by eliminating the cumbersome mechanical cooling components and reducing the size. "Without this, saving the IRST would not be feasible."

At the heart of the IR system is the lead selenide cross-array detector, which senses radiation from a target. Located in the seeker head on the fuselage (see photo), it moves on a gimbaled mechanism to track the target. The system also includes a data processor, a computer to calculate range, servo circuitry, and an interface to tie it into the radar. Data is displayed on the radar scope. If the IR program goes into full-blown operation, Hughes will upgrade these 20-year-old parts—which use vacuum tubes—with solid-state technology.



Infrared heart. The heart of the IR system is the lead selenide cross-array detector, located in the seeker head on the fuselage. It moves on a gimbaled mechanism to track a target.

Adding the IRST to Air National Guard fighters looks promising from the military side, too. "It has real merit—in this case, avoiding a dead spot in the air defense world," says Col. Paul H. O'Donnell, chief of the Air National Guard's Fighter Weapons Office. Furthermore, IR's passive nature makes the F-4s immune to jamming, "something the current generation of fighters doesn't have." Because the IRST is proven technology, Col. O'Donnell expects no hitches in flight tests.

The present $1.5 million contract with Hughes covers work through testing. To cannibalize F-106s and install units in 180 F-4s will cost at least $25 million, estimates Steigleder. But this is less than 10% of the original cost of developing and building the IRST. It is also far cheaper than designing a new IR system that would undoubtedly use color imaging techniques. No such advanced IR system is being developed, says an Air Force spokesman. *–Larry Waller*

AEROSPACE

EUROPEANS AIM PROBE AT HALLEY'S COMET

Paris

The European Space Agency intends to get the closest look ever this year at Halley's Comet, which visits the earth's vicinity only once every 75 or 76 years. Last week, the ESA launched its Giotto spacecraft on a nine-month voyage that will take it on a near-collision course with the comet—to within 310 miles of its nucleus. Once there, it will relay to earth video images and sensory data of the comet.

The ESA named the probe after Giotto di Bondone, the medieval Florentine painter who depicted Halley's Comet in his painting of the adoration of the Magi. It is one of five designed to explore the mysterious body. But none of the others—two from the Soviet Union and two from Japan—will venture nearly as close as Giotto. The others will make their observations at distances ranging from 6,200 to 124,000 miles.

Giotto's close pass will put significantly more stringent demands on the mission hardware than would a pass at a safer distance. In spite of a sophisticated dust-protection system, for example, Giotto will run a high risk of damage or destruction during its encounter with the comet.

Thus Giotto will transmit all acquired data in real time. Standard practice in space missions is to record data and retransmit it after acquisition.

The principal contractor for Giotto is British Aerospace, the UK company leading a consortium of 12 other European companies in developing a spacecraft that can conduct 10 different experiments and relay the raw data to earth.

The craft will use a color charge-coupled-device camera, mass spectrometers, and a series of impact sensors to perform imaging, measurements, and composition analyses of the comet's coma—the gaseous envelope that surrounds the nucleus of a comet—and nucleus during a four-hour encounter.

Giotto will relay data on Halley's Comet in real time

The keys to transmitting the data to earth are Giotto's data-handling and telecommunications systems. The latter consists of a central terminal unit, which in turn consists of two fully redundant central terminal modules, "watchdog" circuitry for fault detection, a power-distribution module, and a data codec.

A master clock oscillator operating at 4.4 MHz provides timing, control, and synchronization signals for the experiments. Each central terminal module unit relies on an RCA Corp. 1802 CMOS microprocessor to provide automatic functions.

The modules also control the craft's telemetry function. This includes the collection of experimental data, the formatting and encoding of the collected data, and the interface with the telecommunications subsystem, which has both active and standby redundant units with failsafe interconnection hardware.

Closeness counts. The success of the Giotto mission will depend to a large extent on how close the craft can come to Halley's nucleus, the small body in the center of the comet from which all activity emanates. For that, the ESA will be depending on a substantial amount of help from its friends.

The Soviet and Japanese missions will make their respective flybys between four and seven days before Giotto makes its pass. They have signed an agreement called Pathfinder with the U.S. National Aeronautics and Space Administration, whose International Cometary Explorer spacecraft will also observe Giotto from afar. This accord will provide the ESA with data that should pinpoint the nucleus more easily and help the craft avoid dust jets, those regions in the comet's atmosphere where Giotto would be most vulnerable to damage. *–Robert T. Gallagher*

TECHNOLOGY TRANSFER

U.S. TO GET FIRST MILITARY TECHNOLOGY FROM JAPAN

Tokyo

An infrared electro-optic missile-tracking guidance system developed by the Japan Defense Agency (JDA) is about to win a modest place in history: it is the first military technology Japan has transferred to the U.S.

Final negotiations are under way in Tokyo to arrange the details of the transfer, which will implement a November 1983 bilateral government agreement in which Japan made an exception to its policy banning all exports of military technology. The new policy, actively promoted by Prime Minister Yasuhiro Nakasone, uses the U.S.-Japan Security Treaty as a special pretext for setting up technology transfer. Because a government agency—the JDA's Technical Research and Development Institute—developed the missile-tracking system, the transfer needs only formal approval by the relevant ministries—Foreign Affairs and International Trade and Industry—thus avoiding what would be a hot debate in the Japanese Diet.

IR electro-optic tracker said to be more reliable

The transfer of the JDA missile-tracking system, which U.S. sources believe may be more reliable, accurate, and resistant to countermeasures than any comparable weapon in the Pentagon's arsenal, will be announced by September. Within weeks of the formal announcement, U.S. government officials will have in hand a data package and equipment samples.

Cuts development costs. The Pentagon has been trying to implement the technology-transfer system to reduce development costs of new equipment and promote use of similar hardware by U.S. and Japanese defense forces.

This first military technology transfer's timing is important for several reasons. It has been almost two years since Prime Minister Nakasone made his pledge to President Reagan to transfer military technology, and the Japanese leader wants action before the November anniversary. He also wants to follow up his recent statement of support for President Reagan's Strategic Defense Initiative. Japanese technical cooperation could aid the Star Wars program substantially. The move also would signal private industry to begin making agreements with its U.S. counterparts.

Negotiations for more private and intergovernmental transfers also are under way, though any agreement is "months away," says a U.S. government official.

Shopping list. Three delegations from the U.S. have visited Tokyo within the past two years to gather information on Japanese research and development in military-application technologies. Last summer, the Defense Science Board, which advises the Department of Defense, produced a study based on its visit; that study focused on technology transfer in 16 categories, which included gallium arsenide semiconductors, fiber optics, ceramics, systems for voice-pattern recognition, and systems for computer-aided design.

A new mood of cooperation may be emerging, but skeptics remain on both sides. Major Japanese electronics companies are reluctant to part with leading-

Wants a transfer. Japan's Prime Minister Yasuhiro Nakasone is eager to start transfers of military technology to the U.S.

edge technology, and some U.S. officials have reservations about allowing access to what they believe is sensitive technology, especially when it relates to electronic countermeasures.

Three times in the past three years, there have been cases in which Pentagon pressure apparently led to forced sales of Japanese acquisitions in the U.S. Most recently, in February 1983, Kyocera Corp. had to sell Dexcel Inc. to Gould Inc., Rolling Meadows, Ill. The sale of the Santa Clara, Calif., firm, which produces leading-edge parts that are used in U.S. defense equipment, was completed last year. *–Michael Berger*

U.S. SEEKS BETTER WAYS TO MONITOR JAPAN R&D

Gaithersburg, Md.

Most U.S. electronics makers know only too well that Japan is a formidable international competitor. But few have a solid idea of what really is going on across the Pacific in science and technology. Westerners who read Japanese well are scarce, and a scant 20% of publicly available Japanese technical literature is currently being translated into English.

That telling statistic came up frequently at the seminar here late in June on access to Japanese technical literature. Sponsored by the National Bureau of Standards and the Institute of Electrical and Electronics Engineers, the seminar was an initial attempt to bring representatives of the federal government, industry, professional societies, and academia together to devise a strategy for monitoring Japanese electronics developments.

Needed: more engineers skilled in Japanese

Language barrier. Not surprisingly, there was general agreement that the major barrier to access was the Japanese language and that there is a growing need to add the study of Japanese to the U.S. engineering curriculum. What is needed now, argues Pat Hill Hubbard, vice president of the American Electronics Association, is a "national consensus" that Japanese-language training is important for U.S. engineering students and graduates.

She says 34 U.S. companies operating in Japan with more than 6,500 employees support the AEA's Japanese-language program. Of these, 19 have provided financial backing. But Hubbard adds, "Clearly, our small pilot project is not going to be the answer."

"The most important tool of all is a Japanese-language capacity," concurs Jan Vardaman of Microelectronics and Computer Technology Corp.'s International Liaison Office in Austin, Texas. Because there are so few Japanese-speaking Americans, the information flows only one way, she maintains.

The tendency since the end of World War II to adopt English as a universal technology language has also contributed to the current inability to track Japanese literature. "Computer developments since 1950 have taken place almost entirely in English," explains Jacob Schwartz, a member of the computer science department at New York University. Hence, Schwartz told the seminar, there is "no tradition [here] of tracking foreign-language publications." In a reference to the current stiff competition between U.S. and Japanese electronics firms, he adds, "The consequences of that are clear."

Nonetheless, scattered government and industry efforts to monitor Japanese technical literature do exist. Motorola Inc., which has relatively large operations in Japan, monitors Japanese technical developments through its Analytical Information and Research Office in Schaumburg, Ill. The office is designed to systematically monitor technical data from around the world, especially technical literature from Japan, says Robert Gonzalez, a Motorola regional analyst.

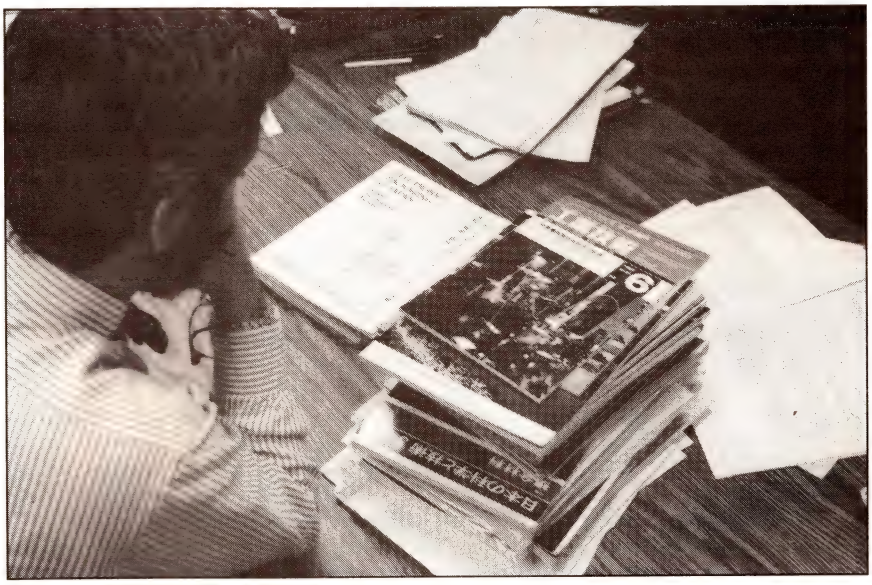
Developments that Motorola watches closely include interconnect substrates and printed-circuit boards (especially surface-mount technology), semiconductor packaging, board assembly, and automatic final-product assembly, adds Mauro Walker, vice president of Motorola's technical staff. Walker believes the most valuable source of Japanese technical information is international technical societies and conferences.

Collecting documents. At the Commerce Department, the National Technical Information Service maintains a collection of about 400,000 foreign documents and has recently reached agreements with 18 Japanese groups to acquire additional technical information. The International Trade Administration also attempts to gather timely and relevant sources of information on Japanese non-silicon-based microelectronics and computer science. In addition, the National Science Foundation maintains a one-person "listening post" in Tokyo that culls the Japanese press for technical developments.

Meanwhile, the Japan Information Center for Science and Technology (JICST) represents a coordinated Japanese effort to collect, process, and distribute international technical data. According to Yoshio Osado of the Mitsubishi Research Institute in Washington, which helps operate the center, the JICST collection consists of nearly 11,000 technical journals including about 40% that are Japanese and 21% published in the U.S.

But an attempt by a New York firm to develop an equivalent data base was dropped last fall when it failed to generate enough user support.

Says Herbert Landau, president of Engineering Information Inc., "U.S. industry and government, on the whole, are not yet prepared to support a national effort to acquire Japanese technical literature." *–George Leopold*



Barrier. Keeping up with Japanese electronics developments is difficult for most American engineers because only 20% of Japan's technical literature is translated into English.

IBM GETS A PARTNER AND UNLOADS A PROBLEM WITH MCI DEAL

by Robert J. Kozma

BIG BLUE FIXES SATELLITE-BUSINESS WOES, MCI GAINS STRENGTH, AND AT&T FINDS AMMO FOR FURTHER DEREGULATION

New York

Not even IBM Corp. is omnipotent, and last week the company proved it by reaching out to MCI Communications Corp. for help in the telecommunications arena. Early indications are that both firms came out winners in the deal, which sends Satellite Business Systems to MCI and gives IBM a chunk of MCI stock in return.

Selling SBS gets IBM out of a sticky situation—SBS was turning into a financial quagmire and IBM, which owns 60% of the satellite company, couldn't see any way out of the problem. But it manages to stay in a business it still finds attractive—now with a strong partner—and strengthens its role as a full-line supplier of information-processing equipment and services.

"In the short term, IBM gets a home for SBS. That's been a worry for IBM for the last two years," says George Colony, president of Forrester Research Inc., a market research firm in Cambridge, Mass.

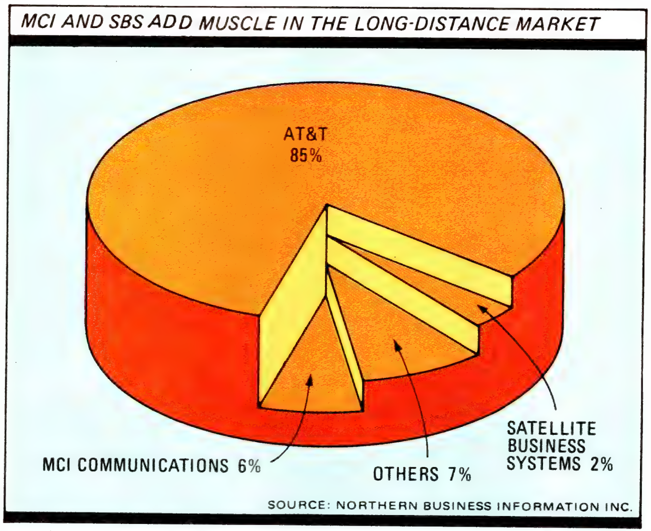
According to informed sources, when IBM executive Stephen B. Schwartz went from his spot as vice president for Asian staff operations to president of SBS in January 1984, he reportedly got one year to come up with a plan to reorganize SBS or sell it.

(Schwartz, now back with IBM as a vice president and assistant group executive in charge of the telecommunications products organization at IBM's Information Systems and Communications Group, is chairman of the SBS Partners Committee—the joint group staffed by executives from IBM and its SBS partner, Aetna Life & Casualty Co.—that oversees SBS.)

"IBM management felt that it didn't know how to run a telecommunications business," Colony continues. "SBS needed an overlord." MCI chairman William G. McGowan made the case that he could run SBS successfully, he adds. Says a spokesman for MCI: "IBM recognized that we are a leader in the telecommunications business. We know how to operate a network."

When IBM, the largest information-processing company in the world—and one of the top 10 companies in the U.S.—needs help, it does something about it. When the computer manufacturer ran into difficulties developing its own telecommunications products, it allied itself first with Mitel Corp. and then, when that firm couldn't deliver, switched its allegiance to Rolm Corp.

MCI AND SBS ADD MUSCLE IN THE LONG-DISTANCE MARKET



SOURCE: NORTHERN BUSINESS INFORMATION INC.

Under terms of the agreement between IBM and MCI, which was made public last week, the telecomunications company will acquire nearly all of SBS. In exchange, IBM gets roughly 16% of MCI's common stock, with options to buy more. IBM agreed not to increase its holdings in MCI beyond 30% without the company's approval [*Electronics*, July 1, p. 11]. IBM also agreed to buy Aetna's 40% share in SBS for an undisclosed amount and to assume all of SBS's outstanding debt, which now totals about $400 million.

In announcing the agreement, McGowan, who initiated talks with IBM two months ago, said, "The merger of MCI's and SBS's organizations would provide an extraordinarily skilled team to meet the telecommunications needs of the most sophisticated users in the market."

This "skilled team" in the telecommunications market will provide the long-term benefits to IBM, observers think. "IBM has a continuing interest in the telecommunications-services industry," emphasized IBM president and chief executive John Akers.

"Last year, AT&T decided to get [deeper] into computers," says Jean E. Graham, a telecommunications analyst at Dataquest Inc., a market research firm in San Jose, Calif. "This is IBM's statement back to AT&T that it's willing to get into all parts of the business."

SBS was not the right way for IBM to penetrate this market. For one thing, the effort to build up the SBS joint venture was expensive—up to $1 billion of the $1.3 billion invested in SBS by the partners came from IBM, and that amount will grow. For another, some say the satellite company was ineffective. Right now, the primary communications need of large corporate accounts is voice communications. Data transmission, though important, takes a back seat.

Satellite technology, on which SBS relies, doesn't handle voice transmission well. "You don't get full-duplex communications over satellite lines," says Francis McInerney, executive vice president of Northern Business Information Inc., a telecom industry market-research firm. This results in a short delay in transmission that users find annoying.

But the all-digital nature of satellite transmission works extremely well for data transmission. So in effect, SBS pitched its ability to handle data transmission first and voice transmission second, though customers needed voice transmission first and data second. (MCI says it plans to offload the voice traffic from SBS to MCI's terrestrial facilities and free up SBS for data handling.)

Besides freeing IBM from SBS, the deal with MCI lets the computer giant reinvest in the same business with a strong participant, points out Arthur H. Solomon, vice president and manager of the telecommunications section at Arthur D. Little Inc., the Cambridge market research and consulting firm. "IBM's goal is to become strong in all areas of telecommunications. It's investment in SBS was consistent with that goal. The SBS investment didn't pay off, but the goal is still there. The deal with MCI gives them another shot."

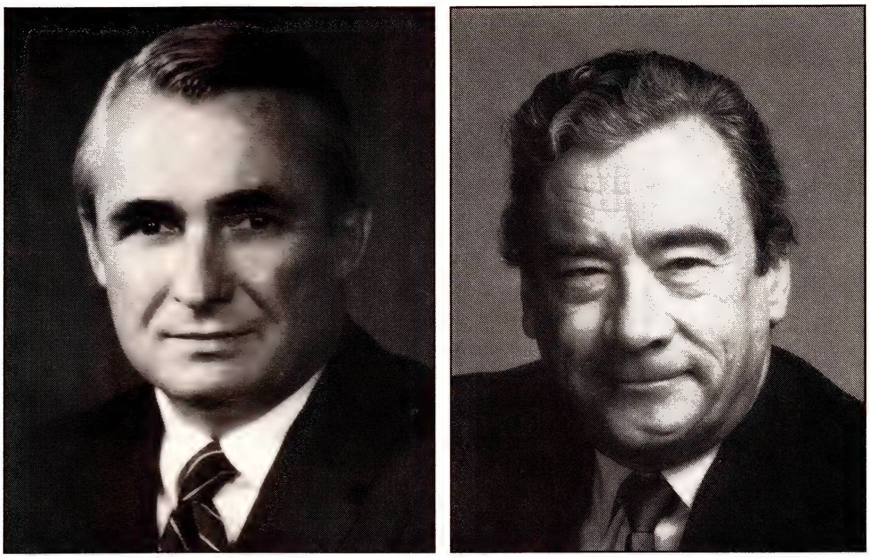
One-stop shop. Observers note that in the future, users could think of IBM as a one-stop shopping center for information-processing products and services. IBM salespeople can sell mainframes and personal computers, link them up by telecommunications equipment from Rolm, and then recommend that customers tie the whole system together with MCI's network.

"The relationship with MCI is most important, especially if they can do joint marketing," says Karen Mulvaney, an analyst with L. F. Rothschild, Unterberg, Towbin, in San Francisco. "IBM was allowed to do [joint marketing] with SBS."

For MCI, the addition of SBS and its 200,000 subscribers and its satellite communications network will help it compete more effectively—and profitably—with AT&T. "There has been some concern over MCI's ability to finance its growth," notes Mulvaney. "This is a big plus financially." Increased access charges have eroded MCI's price advantage over AT&T, she notes, while MCI's investment in its communications network has gobbled up big chunks of money. (An MCI spokesman notes that the company has invested $3 billion over the past three years as it added 340 million circuit miles of optical fiber, microwave relays, and satellite capability.)

But enhanced financial strength isn't the only benefit. What may be more important is that MCI gets the IBM seal of approval and the marketing clout that goes along with that, observers note.

MCI's alliance with IBM "gives it increased credibility" as a vendor, says Arthur D. Little's Solomon. "Many people have doubts about the staying power of the common carriers in the face of AT&T." IBM as a part owner is "a vote of approval in MCI by IBM and will be a strong psychological shot in the arm for MCI." Adds Dataquest's Graham: "Anybody who partners with IBM benefits."


Partners. IBM Corp. president John Akers (left) and MCI Communications Corp. chairman William G. McGowan will have to decide if their firms should get married or just be friends.

But anyone who does business with IBM also risks getting absorbed. Observers think the odds are good that Big Blue will acquire all of MCI over time, something that both IBM and MCI deny will happen. "If the example of Rolm is any guide—and I think it is—it will happen," says Solomon. With Rolm, the plan was to jointly market products. "IBM couldn't control Rolm's business and Rolm was unwilling to yield sovereignty to IBM," which necessitated Rolm's acquisition by IBM. The same thing will happen here, he thinks.

'IBM didn't know how to run a telecom business'

Battle of wills? "IBM will want to dictate, and MCI is not likely to take dictation. It's a question of whether IBM feels strongly enough about acquiring and merging MCI and whether McGowan feels like giving up his sovereignty." As for right now, though, "They will continue to view each other with some suspicion and affection, trying to decide if they want to get married or just be friends."

Ironically, the IBM-MCI agreement also benefits AT&T. Analysts note that AT&T could go to the Federal Communications Commission and request freedom from all regulatory restraints so that it can compete more effectively with IBM-backed MCI. "AT&T may not be worried [by the combination of IBM and MCI], but they will appear to be worried" so they can convince the FCC to drop the provisions of Computer Inquiry II or get the FCC to regulate IBM, notes analyst McInerney.

No leverage. Under the provisions of Computer Inquiry II, AT&T's computer products operations are kept separate from its communications operations. "This has prevented [AT&T] from taking full advantage" of merging the two operations. But with IBM free to offer computer products and its partner, MCI, offering communications services, "AT&T can argue that the FCC should drop the regulations or regulate both," McInerney says.

Another AT&T fallout from the IBM-MCI move could be an increased need to acquire a computer company, thinks Forrester's Colony. "AT&T has got to make an acquisition in the computer industry within six months" to counter IBM, he argues. Among his suggested candidates: Digital Equipment Corp., Data General, Wang Laboratories, Hewlett-Packard, and Prime Computer.

"These companies have got to realize that they can't compete," without such a linkup, he says. "It would behoove them to make their peace with AT&T and become part of a consortium." Colony argues that when the synergy of IBM and MCI is examined, "you begin to see the disadvantages for the second- and third-tier vendors." ☐

IBM CORP. EXPANDS ITS ELECTRONICS EMPIRE

Company	IBM ownership	Products/services	1984 revenues
MCI Communications Corp.	16%	Voice and data communications	$1.6 billion
Intel Corp.	20%	Semiconductors	$1.6 billion
Rolm Corp.	100%	Telecommunications equipment	$660 million

BRITAIN MAKES MAJOR BID TO BUILD COMMERCIAL FIFTH-GENERATION MACHINE

by Kevin Smith

FLAGSHIP LEAPS FROM UNIVERSITY R&D PROJECT TO THREE-YEAR $20 MILLION EFFORT FOR BRITISH INDUSTRY

London

Britain's fifth-generation computer project—now known officially as Flagship—is moving from a university-based research effort into a heavily funded plan to produce a commercial machine. This rapid shift points up the major changes taking place throughout the British computer industry.

The decision to go all out with a single project was prompted by Japan's very ambitious fifth-generation-computer effort. As the Japanese view it, the next generation of machines will be marked by a shift to more powerful languages, to highly parallel and expandable computers that break with past architectures, and to machines that take on human-like characteristics, such as speech synthesis and voice and pattern recognition.

British Flagship backers do not see the project as a purely national effort. D. B. Thomas, director of the Intelligent Knowledge Base Systems group within the Alvey fifth-generation directorate, would like Flagship to be the basis for a worldwide open-system architecture for fifth-generation computers.

Backers see program as global effort

"This is all to do with changing attitudes," he points out. By publishing its Declarative Alvey Compiler Target Language (Dactl) for parallel computing, Alvey hopes to establish a framework for collaboration with Europe and, more cautiously, with Japan.

Flagship, based on work at Imperial College and at London and Manchester universities, will run declarative fifth-generation-computer languages. The $20 million three-year project will be the largest single venture funded by the Alvey directorate. International Computers Ltd. plc will lead the project; The Plessey Co. plc is charged with creating the first large-scale demonstrator.

The already funded Plessey-led consortium plans to produce a practical speech-recognition system based on a forerunner of Flagship—Imperial College's Alice (for Applicative Language Idealized Computing Engine). The aim is to use expert-system techniques to produce a computer with a 5,000-word vocabulary. It will recognize connected speech and adapt to different speakers.

University roots. The project has its roots in an early-1970s university research program into distributed computing. This initiative by the Science and Engineering Research Council helped lay the groundwork for Britain's current strong research position in novel computer architectures. Oxford University's Tony Hoare tackled one of the key theoretical problems associated with getting large numbers of processors to work together. His CSP parallel-processing language was the starting point for Occam, Inmos Ltd.'s commercial language derivative.

On the hardware side, radically new architectures that break with the traditional von Neumann computing model began to emerge. Two of these machines, Manchester University's data-flow computer and Imperial College's Alice, led the way.

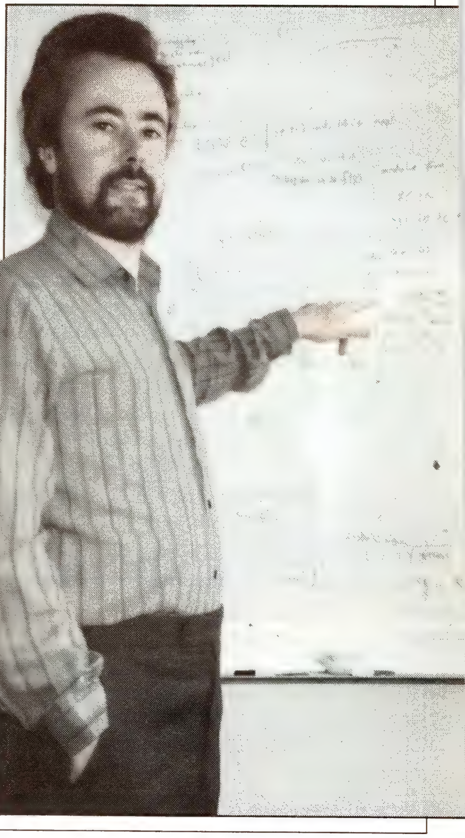
Manchester University, traditionally a stronghold of British computing, ran one of the industry's first data-flow computers in October 1981. The Manchester team, headed by John Gurd and Ian Watson, has since demonstrated that data-flow machines produce a "linear speed-up" as more processors are added.

They demonstrated that doubling the number of processors also doubles the performance. In a von Neumann machine, extra processors get in each other's way and their performance degrades. Cracking this problem opens the way to developing computers of unlimited power.

Meanwhile, researchers at Imperial College worked on new computer languages grounded in mathematics and logic and derived from first principles without regard to the hardware on which they run. Among the Imperial College team are Bob Kowalski, a leading proponent of Prolog, and John Darlington, who created the graph-reduction language HOPE. In these so-called declarative languages, the program is set down or declared in a series of logical statements.

Declarative languages are fundamentally different from today's procedural languages. A procedural program is analogous to teaching arithmetic to a beginner, who performs by rote an exact sequence of instructions for adding columns, carrying to the next, and so on. Declarative languages, on the other hand, work like sets of simultaneous equations, which the programmer sets

In reverse. John Darlington helped design a computer to run his declarative language.



up and the machine solves in any order.

In theory, declarative languages are extremely powerful, but in practice they run slowly on conventional computers. Realizing that such languages might map better onto a data-flow machine, Darlington and Mike Reeve, the leaders of the Imperial College research team, began a hardware design for running fifth-generation languages. Alice, says Darlington, is one of the first computers to be designed by a language expert rather than a hardware engineer. The design, which is all but completed, only awaits the first transputers to come off Inmos's production line [*Electronics*, Feb. 24, 1983, p. 67].

Britain shaken. Until four years ago, Manchester's data-flow computer, and Alice would probably have remained academic research exercises with no industrial follow-through. But a conference held in Tokyo in 1981 changed all that. Japan's fifth-generation-computer plans shook Britain out of its torpor and the similarly targeted Alvey program quickly followed.

Even before the program got under way, UK companies were scouring the universities for technology. ICL quickly agreed to construct the Alice hardware for Imperial College. Meanwhile, a Plessey-led consortium got funding to develop an ambitious speech-recognition system based on Alice.

As the program got going, it soon became clear that Alvey lacked an architectures strategy. Twelve studies were funded, but the Alvey directorate had to decide which one it should go for and how the others should be supported.

Alice and the data-flow machine were clear favorites, and Thomas asked the two teams to sort something out. There was common ground. Says Manchester's Watson, who will now work on Flagship with university researcher J. V. Woods, "People forget that the two approaches came from the same route."

"Watson concluded that the Alice computer was more flexible than the data-flow model," says Alvey's Thomas. Yet, adds Watson, the Alice team sacrificed some of the principles that are essential to obtain linear speedup. In Alice, a fast central switch connects a pool of processors to a large memory array. That switch is a potential communications bottleneck.

Alvey is looking to create an open standard

There is another essential difference between Alice and Flagship, Watson explains. "Any parallel processor has to be composed of building blocks. The trouble with the transputer is that the building block is too small for us. We intend to build much bigger building blocks in VLSI with a megabyte of off-chip storage and high-speed processing capability."

The project has escalated from a small research program to a full-scale computer-development plan, including operating system, compilers, and eventually a complete very large-scale-integration implementation. "It is going to be the most expensive project we fund," says Thomas. Industry will be expected to chip in around half the cost.

The importance of Flagship to ICL is underlined by the appointment of Colin Skelton, a hard-driving project director, to head the program. Skelton comes to Flagship fresh from launching ICL's new office mainframe, the Level 30.

"I have established a reputation for bringing a project in on time," he remarks. Working in a university environment is a novel experience for Skelton. He admits he felt self-conscious in his business suit during the first meetings with his easier-going, casually dressed academic colleagues. But he says the collaboration is working well.

ICL's past efforts to leapfrog the industry have been inconsistent. Its Content Addressable File Store is now standard to all ICL mainframes, but its Distributed Array Processor still has not yet come to market. Skelton is determined that this will not happen to Flagship. "There is no way I am going to make a product that is a white elephant," he says.

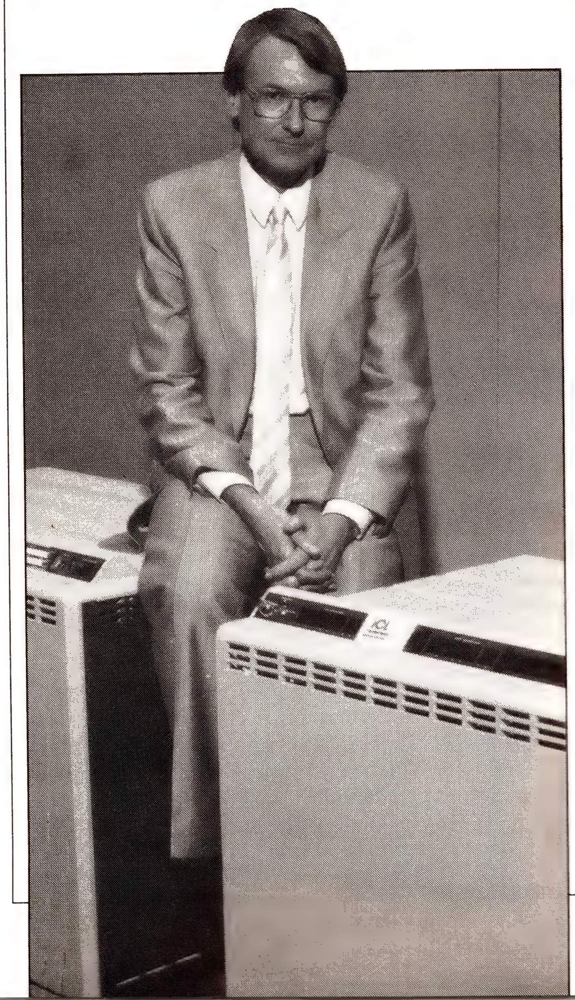
Still, ICL is a midget on a world stage and lacks the muscle to impose a fifth-generation standard on the industry. The Alvey directorate understands that and is looking instead to cooperate with Europe and possibly Japan in creating an open standard for fifth-generation computers. Such an approach has its attractions, but it may not be practical.

The basis for this standard would be a virtual or imaginary machine. Industry understands the concept and would provide a stable architecture for the development of software that allows applications programs to move from one parallel-processing machine to another. Manchester and Imperial College already are working on defining Dactl, written for that virtual machine.

Public domain. The language, says Thomas, "will be put in the public domain, to encourage international standardization." In this way, he adds, Flagship could become a test bed for a variety of hard-wired parallel-processing architectures. Thomas hopes that Dactl will play a key role in the European Esprit program. "It just does not make sense to have a British declarative target language."

Skelton agrees on the need for an open-systems standard for fifth-generation computers. "Without it, IBM will come along with its own standard and flatten us all," he remarks. He visualizes an interface that "machines can work up to and languages can work down to." The right collaborative links are already in place, through Alvey and Esprit, and at the company level, through a fifth-generation research laboratory that has received funding from Siemens, ICL, and Nixdorf.

A Japanese connection is still a possibility. Imperial College's Reeve was recently in Japan to talk about Dactl. But one major snag is that the Japanese shy away from talk about intellectual-property rights. Thus talk of international collaboration may be premature. Flagship funding has yet to be agreed on, and there is one nasty historic precedent to overcome. *Mary Rose*, Henry VIII's recently salvaged flagship, turned belly-up on her maiden voyage. ☐



Commanding. Colin Skelton is the new head of the Flagship computer-architecture project.

COMPUTER MAKERS HEAD SOUTH OF THE BORDER FOR NEW MARKETS

by J. Robert Lineback

HOPES RUN HIGH THAT MEXICO WILL LOOSEN CONTROLS, PROVIDING FUTURE ENTRY INTO LATIN AMERICA

Mexico City

Computer sales are going south in more ways than one. With domestic shipments remaining in a slump during 1985's dismal downturn, U.S. equipment makers are heading for the Mexican border.

Their aim is to secure a stronger foothold in the tightly controlled but lucrative Mexican computer markets. Without a presence there, most vendors fear it will be impossible to tap any future emerging business in Latin America.

Among the U.S. firms speedily setting up new manufacturing shops in Mexico are Tandy, Sperry, and Wang. Minicomputer merchants Digital Equipment Corp. and Data General Corp. are in the final rounds of negotiations with the Mexican government. The two hope to announce separate production plans this summer.

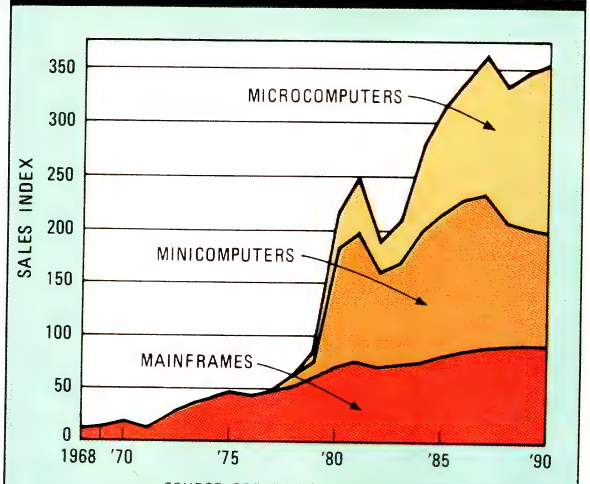
But IBM Corp. is getting the most attention in what some competitors claim is an attempt to bend the original 1982 controls on personal computers. IBM is reportedly close to reaching a precedent-setting agreement with Mexico's National Foreign Investment Commission. In January, the commission turned down the U.S. computer giant's 1984 proposal for a special permit allowing 100% foreign ownership of computer plants.

In March, IBM revised its proposal, reportedly to include higher export levels from Mexico, increased research and development at the site, the use of more locally supplied components, and quicker introductions of advanced systems in the market. If approved, the accord will give IBM full ownership of personal computer assembly at its 10-year-old manufacturing complex in El Salto Helisco, near Guadalajara, where the firm now makes electronic typewriters and the System 36 multiuser computer.

"The IBM case is a big issue there because the company is trying to beef up its investment, but at the same time it wants to hold on to the 100% worldwide ownership policy," notes William P. Glade, who tracks Mexican industrial policies at the University of Texas at Austin's Institute of Latin American Studies.

Highly centralized. "There are several reasons for the general interest in the country," notes Fred Withington, an analyst at Arthur D. Little Inc., Cambridge, Mass. "First, the market size is significant enough, and Mexico's highly centralized business structure means very large business buyers of computers. Mexico, with low labor costs, is also a good candidate for manufacturing for export—especially back to the U.S."

THE MEXICAN COMPUTER MARKET KEEPS CLIMBING



SOURCE: CREATIVE STRATEGIES INTERNATIONAL CORP.

But Mexico's still-struggling economy is scaring off many players, notes Glade. "The one thing they're frightened of is the Mexican exchange-rate policy. If the peso is ever allowed to become drastically overvalued, it would wipe out the usefulness of Mexico as an export platform. Certainly, with a number of Asian sites coming on strong, the Mexico export platform could be precarious, except if it is used as a sheltered entrée into Latin America." That's exactly what most count on.

For example, Tandy Corp., which had enjoyed strong personal computer sales in Mexico prior to the import restrictions, believes it now has a jump on IBM. That comes with last month's first shipments of its Tandy 1000 computers from a plant operated by Computadoras y Asesoramiento SA, in Mexico City. The machines are compatible with IBM Personal Computers.

States Jerry Colella, vice president of Radio Shack International: "We know there is a market in Mexico, and we know now buyers are crying for products of this type because of the import restrictions. We are not there just because we think the market is product starved, but because we feel it has long-term growth potential." Tandy's contract with its Mexican-manufacturing partner allows for export of systems throughout Latin America.

In Irapuato, Sperry Corp. has licensed the manufacture of a microcomputer to Microsystemas Micron SA. Just starting in production, the 68000-based unit is compatible with Sperry's microcomputer. Like most assembly pacts, Sperry initially is supplying nearly all the system's components. The computer and manufacturing agreement has been designed to phase in Mexican-supplied contents, says Pehr Leufven, marketing director of Pacific-Latin America Group in the International Division, Blue Bell, Pa.

"Import restrictions are not the only reason for building in Mexico," explains Leufven. "We are having trouble in overseas markets with the strong dollar. That makes it difficult to export products competitively from the U.S., particularly when a [local] currency is weak."

This summer, Tandy and Sperry will join Hewlett-Packard Co. and Apple Computer Inc., which are already in volume production of personal computers in Mexico. In April 1984, Hewlett-Packard Mexicana SA signed a joint-venture agreement with DESC Sociedad de Fomento Industrial SA to make HP 150 touchscreen personal computers. Micro-

Computadoras Hewlett-Packard SA, the joint venture in Guadalajara, is owned 51% by DESC and 49% by the Palo Alto firm. HP has also been making its System 3000 business computers in Guadalajara since 1982.

Blossoming. Apple, whose sales are slow in the U.S., believes Mexico and other Latin American markets are ready to explode. Expecting market demand to grow nearly five times in the next three years (see figure), the firm's year-old Apple de Mexico SA plant in Mexico City is cranking out the Apple IIe. To date, demand in the Mexican market has been 25% higher than anticipated.

With 60% of Mexico's population under 21 years of age, Apple expects to find high growth in educational markets. In June, the firm announced a three-year sales agreement for 10,000 computers to Institute de Technologico de Monterrey. A study of the still-infant Mexican computer market by Creative Strategies International, San Jose, Calif., estimates revenues for desktop computers were only $20 million in 1982. Under the current industry controls, sales are expected to be more than $102 million in 1987.

Though that growth represents a compounded annual rate of 39%, sales of personal computers actually fell in 1982 by more than half the $43 million revenues recorded in 1981. The plunge was blamed on the import restriction on personal computers (see "Mexico softens some of its tough policies"). Ironically, the restriction is now attracting some U.S. manufacturers, because control limits the field of competitors and keeps costly price wars to a minimum.

Creative Strategies says that Mexico's minicomputer market has been growing at about 20% per year, with sales expected to hit $159 million this year compared with only $91 million in 1982. A decline in the large systems sales could begin around 1987, however. The study concludes that minicomputer sales will fall off when the Mexican-owned personal computer industry begins filling unmet demand, stealing business from foreign suppliers.

"Ultimately, the reason for being down there is from a manufacturing-dollar standpoint," notes computer-industry analyst Tim Bajarin of Creative Strategies. "Unlike offshore assembly trends, I don't think we'll see peripheral manufacturing going that direction. The infrastructure is simply not there, and unless you already have a foothold into the Mexican computer industry, it will be very hard to succeed."

Awaiting approval of its proposed assembly operations, DEC hopes to recoup the business it lost when Mexico began weighing computer imports against exports. "The Mexican màrket is a fairly attractive one because of its size," says Phillip Kauffman, general international regional sales manager. "Outside Brazil, which is the giant of Latin America, Mexico is second. And for us, it was especially attractive because we had carved ourselves a large installed base. That's a niche we have lost."

Recouping. Most new manufacturing plans aim to rejuvenate the weakened positions of leading U.S. suppliers following the start of trade restrictions on small systems nearly four years ago. Mexico's national computer program—which actually is an ambitious plan to spawn a world-class electronics industry by the end of the century—is now focused mostly on desktop systems. Unless a waiver is issued, all microprocessor-based personal computers sold in the Latin American nation must be manufactured domestically by plants with Mexican majority ownership.

Ownership of minicomputer and mainframe assembly plants is currently unrestricted under the current program, but elaborate trade quotas are forcing more large system houses to consider assembly in the country.

To add to the uncertainties, Mexico's Commerce Ministry reportedly is working on a comprehensive electronics program that could replace the series of decrees now making up the computer program. "We have asked them to consultation before that program is promulgated," says John Rosenbaum, U.S. trade respresentative for the Americas. "We have agreed to do that, but we have not yet had that discussion."

The growing pressures of Mexican production have opened up a new contract systems-assembly business for NCR Corp.'s subsidiary in Pueblo. Originally located in Mexico to manufacture cash registers and banking machines, NCR Industrial de Mexico SA de CV became one of the first computer assembly operations in the nation during the 1970s. Today, it is making NCR's Tower multiuser computer and a number of point-of-sale terminals for Mexico as well as 40 other countries.

"We now have another part of our charter here, which is to market Mexico's comparative manufacturing advantages, such as low labor costs," explains Paul E. Fleming, general manager of the subsidiary. "That means we are now bidding to do non-NCR system assembly for companies based in the U.S. and Mexico." □

MEXICO SOFTENS SOME OF ITS TOUGH POLICIES

In an effort to bring more dollars south of the border and spur its technological development, Mexico has backpedaled on some of the restrictive regulations inhibiting U.S. electronics firms.

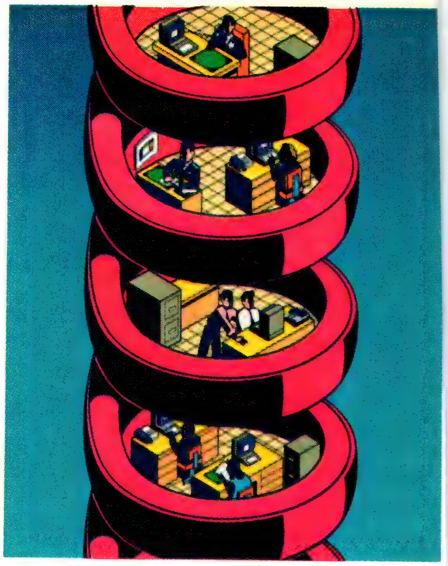
In its attempts to create a small-computer industry, the government restricted imports and foreign investment and gave tax incentives for firms setting up shop in Mexico. Thus firms have had to invest there to get access to the Mexican market. Some government officials admit to a few cases in which computers are taken apart on the U.S. border and reassembled in Mexico. Mexico has targeted the microcomputer industry because "it could never be competitive in minis and mainframes," officials said. "When Mexico targeted microcomputers, it was an emerging industry with the potential to be the most lucrative." They doubt that Mexico will extend its policies in microcomputers to mainframes or minicomputers, or that the country could ever produce mainframes competitively, and said that the minicomputers are increasingly assuming microcomputer characteristics. Industry sources predict that the government will extend concepts of the 1981 national computer-industry development plan in the new electronics program. This means more domestic content in goods assembled in Mexico and a package of export incentives, according to one official.

For foreign firms, though, past practices are causing some second thoughts. One concern is technology transfer. To protect local firms, Mexico's original rules limited royalty payments to foreign firms to a maximum of 2% or 3% of total sales. Many U.S. firms thought this did not reflect a realistic cost of technology, and it may have discouraged foreign investment. This year, Mexico increased the maximum royalty to 6% to 8%. Several years ago, the regulations were expanded to include software.

Lack of enforcement of trademark laws has also had a cooling effect for U.S. companies. Though enforcement seems to have improved recently, Mexico's patent laws still present problems for some foreign firms. U.S. companies have been successful, however, in signing technology-transfer deals in Mexico, particularly in the areas of assembly and education. Contracts with U.S. firms account for 60% to 65% of technology-transfer deals. **–Leslie Ann Layton, McGraw-Hill World News**

Voice Management

Data Management



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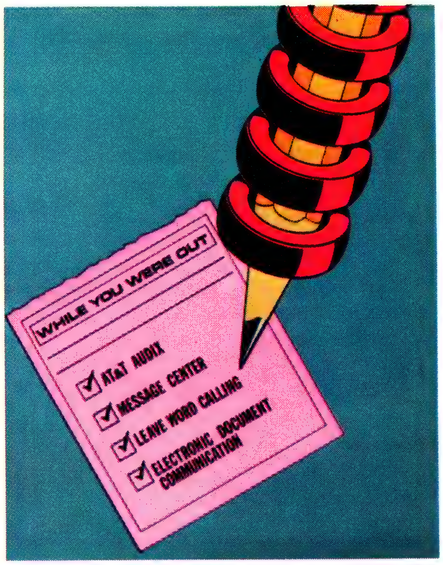
System Management

Office Management



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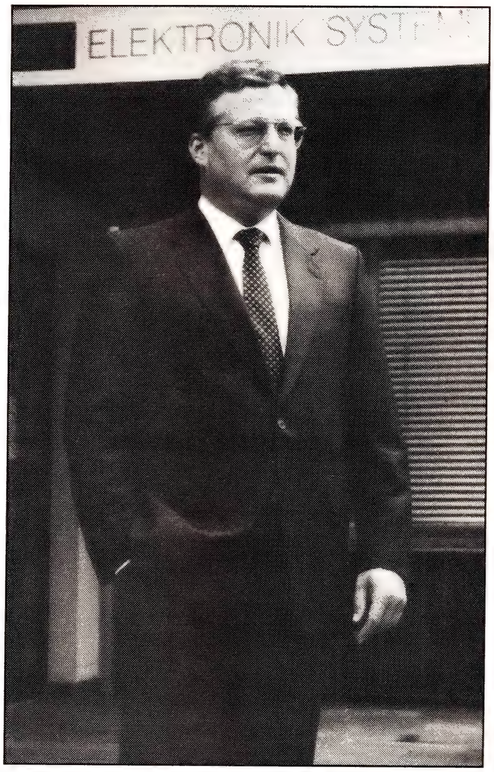
WEST GERMAN COMPANY ATTRACTS U.S. INVESTORS

Peppy VMEbus firm heads for U.S. market with a track record that venture capitalists should find attractive

Kaufbeuren, West Germany

Rare is the foreign company that manages to attract U.S. greenbacks. Fewer than a dozen West German firms with operations in the U.S. have ever enjoyed the largesse of U.S. venture capitalists. Yet it appears that PEP Elektronik Systeme GmbH, an electronics business with a staff of 30 and a Pittsburgh subsidiary, will join that elite circle.

With the help of the state-financed bank-sponsored Penn Southwest Association in Pittsburgh, PEP is likely to get some $2 million of funding this summer from U.S. banks and private investors, for a 10% share of the company. "So lucky circumstances and the right people in the U.S. have helped as much as having the right products for a particular industry," says company president Josef Kreidl.



Fertile ground. Expansion in the U.S. is essential for growth, says PEP president Josef Kreidl.

PEP (for the German words for planning, development, and programming) is one of West Germany's fastest-growing electronics firms. A high flyer in its specialty—VMEbus boards for industrial applications—the company has pushed its business from $1.5 million in 1981 to about $10 million last year.

"We expect to more than double our sales every year in the near-term future," says the 36-year-old Kreidl. That should put PEP in the $100 million league by 1987.

But the company's past performance and its future prospects are not all that make PEP attractive to U.S. investors. There are also its products: single-height 100-by-160-mm VMEbus modules for 8-, 16-, and 32-bit microcomputer applications as well as assembled computer systems. (A VMEbus is a group of 32-bit-wide asynchronous address and data lines for communicating across a computer backplane.) These products are mainly for use in industrial control, robotics, heavy machinery (excavators, for example), machine tools, and automation equipment.

A different valley. The type of customers that PEP attracts influenced the company's choice of location in the U.S. Rather than Silicon Valley, the firm chose to settle in the middle of America's heavy-equipment and machine-building region. Kreidl founded PEP Modular Computers Inc. in Pittsburgh last fall. The firm is banking on nearby Carnegie-Mellon University to fill its need for technically skilled personnel.

The West German company has been active in the U.S. since 1982, operating out of a contact office in Pittsburgh with representatives in major states selling its wares. But now, with the U.S. market looking more and more attractive, Kreidl wants to go all out and set up manufacturing operations there. The subsidiary's sales network in the U.S. now encompasses 15 representatives with offices in 40 states.

The choice of Pittsburgh is another factor in PEP's becoming a strong candidate for investment. As Kreidl explains, Pennsylvania, which has been hard hit by the slump in steel and other smokestack industries, wants to attract new businesses.

Thomas C. Deen, a former executive at Texas Instruments Inc. and now chief executive officer at PEP Modular Computers, runs PEP's U.S. facility, which is expected to start producing computer boards and assembled systems by the middle of next year. The staff will number between 60 and 80; the jobs will range from factory workers to design engineers. "I have put control of the Pittsburgh operation fully into Deen's hands," says Kreidl.

Worldwide, PEP has so far picked up some 2,000 customers. About 50 of them are U.S. buyers, including IBM, Gould, and Combustion Engineering. By the end of this year, Kreidl expects to have 250 U.S. original-equipment manufacturers as customers. The Pittsburgh facility will serve as the base for expanding into the Canadian and South American markets.

PEP's goal of $100 million of business by 1987 would probably be impossible without being active in the U.S., where "new products are accepted much faster than in Europe," says Kreidl. The time between a visit to a U.S. customer and the first orders is only 10 weeks, in contrast to the six to seven months it takes in Europe, he says.

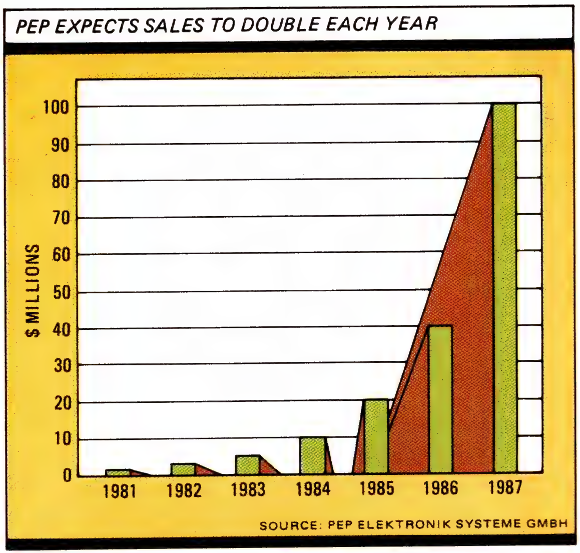
Under pressure. The main reason for faster decision-making in the U.S. is that customers are under heavier pressure to bring new systems to market before the competition does, he explains. This ties in with the fact that U.S. equipment makers prefer to buy computer boards rather than develop such items themselves, whereas many European equipment producers do not.

Success did not come easily to PEP. In 1975, it was founded in this Bavarian town as a design office by five engineers—with Austrian-born and -educated Kreidl among them—who came from an electronics firm that had abandoned its operations here. PEP started out by developing boards and modular computer systems for special customers such as military and aerospace concerns. But disagreements among the founders made for poor business. In all, the company's business totaled just $1.5 million from 1975 through 1980.

Only after Kreidl took the company's reins did it begin to prosper and grow—at annual rates that may be typical for data-processing startups in the U.S. but not in Germany. Kreidl concedes it would have been difficult to sustain the initial growth had not a venture financing company infused $400,000 (to be paid back after 10 years) into PEP's operations. Some funds also came from the Bonn government under a federal research and development promotion program.

Unlike some entrepreneurs in West Germany, Kreidl is not one to criticize German financing institutions for not helping promising young firms get off the ground. German banks are more conservative than those in the U.S., he says. "But they are loosening up. If a

PEP EXPECTS SALES TO DOUBLE EACH YEAR



SOURCE: PEP ELEKTRONIK SYSTEME GMBH

company has growth potential and if there exists an atmosphere of confidence between money lender and receiver, it is now possible to work with German banks and get their help in managing growth."

Global sales. With the money PEP has received from outsiders, the company has expanded its sales network, which now spans Europe, the U.S., and parts of the Far East. Three areas remain: Japan, China, and the Eastern bloc. PEP will set up a sales firm to cover these areas in partnership with a German bank, though details haven't been worked out yet.

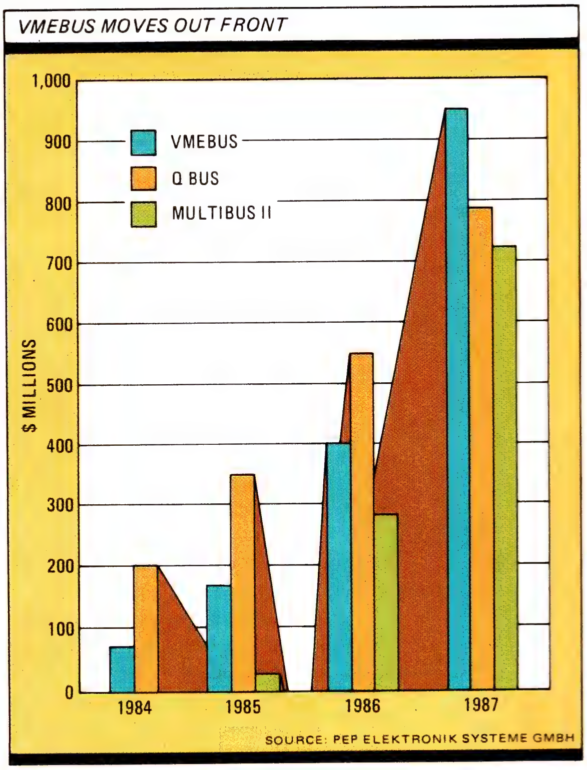
Working out of a three-story building in a Kaufbeuren residential area, PEP remains, in essence, a development organization. Assembly of boards and systems is handled by a subcontractor. That leaves PEP free to design its products, test them, handle parts purchasing and quality assurance, and control sales and marketing. By contrast, the Pittsburgh facility will handle not only development and marketing but also board and system assembly.

The attraction for PEP as a VMEbus 16/32-bit board supplier is a market that, by the company's own estimates, should exceed $950 million in 1987. VMEbus boards are the fastest-rising segment of the 16/32-bit board market, Kreidl maintains.

If PEP now has a 6% share of the VMEbus 16/32-bit board market, it is gunning for better than a 10% share in 1987. That is in line with the company's goal. The firm also has a good idea of where sales will come from: the U.S. ($25 million), West Germany ($20 million), the UK ($10 million), France ($8 million), Japan ($5 million), and the rest of the world ($32 million).

Standing up. What motivates Kreidl in the board business is the success he's had so far and "the urge to stand up to the competition." That competition includes some powerful names in the VMEbus board arena, including market leader Motorola Inc., N.V. Philips and its U.S. affiliate Signetics Corp., and Force Computers Inc.

VMEBUS MOVES OUT FRONT



SOURCE: PEP ELEKTRONIK SYSTEME GMBH

"What sets us apart from most others in the field is what we believe is the superior quality of our products," Kreidl says. He attributes this to the company's early involvement in boards that meet the exacting demands of the military. Although military customers now account for only 5% of PEP's business, the quality consciousness has carried over into the development and manufacture of boards for industrial applications. "Quality governs our design," he says.

The company now carries a line of 120 different VMEbus boards ranging from central processing units to system controllers and memory boards. Intelligent input/output controllers allow the assembly of 8-, 16-, and 32-bit systems. *–John Gosch*

BOTTOM LINES

AIR PRODUCTS BUYS SILICON SUPPLIER

In an effort to bolster its operations in the electronics field, Air Products & Chemicals Inc., Allentown, Pa., has acquired the assets of Materials Technology Corp. from Kirby Exploration Co. Terms were not disclosed. Materials Technology makes ceramic-coated graphite susceptors used to hold and heat silicon wafers during epitaxial deposition. The company also deals in chemical-vapor-deposition technology. In addition, it reprocesses silicon wafers through its Silicon Materials Service Inc. subsidiary. Air Products says the purchase of the two companies follows its acquisition in April 1984 of San Fernando Laboratories, a ceramics company in Los Angeles with 20 years of experience in chemical-vapor-deposition technology. Air Products says that Materials Technology and Silicon Materials Service, which have combined sales of $6 million, will operate as subsidiaries.

MIPS COMPUTER GETS NEW FUNDING

Mips Computer Systems Inc., of Mountain View, Calif., has raised $9.1 million in its second round of venture financing. Mips, which is developing a reduced-instruction-set computer (RISC) for original-equipment and computer manufacturers, says that the funding will take it "through the completion of the developmental stage and into first product shipments, expected in the second quarter of 1986." Founded in August 1984, the company's first financing raised $1.5 million.

IC FIRM MICRO POWER IN PRIVATE PLACEMENT

Micro Power Systems Inc., a Santa Clara, Calif., integrated-circuit maker, received $9 million through a private placement of convertible preferred stock with a group of institutional investors. The company says the new funds will be used to market a new two-chip modem and to eliminate short-term debt.

DAVOX GETS CREDIT LINE FROM BOFA

Davox Corp., a supplier of integrated voice-and-data work-station systems located in Billerica, Mass., has received a $3 million line of credit from the Bank of America. "Our line of credit will provide working capital for the corporation as Davox continues to expand its marketing and development activities," says president Dan A. Hosage.

JERRY KAPLAN SEEKS AI FOR EVERYDAY PROBLEMS

Portola Valley, Calif.

Commercial uses of artificial intelligence have developed mainly through large-scale applications such as expert systems for oil exploration or medical diagnosis. S. Jerrold Kaplan, who helped devise such applications as a founder of Teknowledge Inc., now is trying to domesticate the AI process for microcomputers. As the newly designated chief technologist for Lotus Development Corp., Kaplan directs an effort to use AI for everyday problems.

Kaplan acts as the point man for a loose collaboration between Teknowledge, the Stanford University spinoff that was a pioneer in expert systems, and Lotus, publisher of the bestselling business spreadsheet, 1-2-3. The connection is loose in that Kaplan now works formally for neither company but serves as a consultant to both.

For Teknowledge, his concern is a microcomputer-software project he started as an adjunct to the company's main business, large minicomputer-based applications. For Lotus, he is writing code for a new application that may become a product. For both, he is the liaison in a joint development program.

Though Kaplan won't say what problem the Lotus application solves, it is based on an AI program's ability to monitor its own process and adapt to change. After experiencing a few commands, such programs can begin to make assumptions about their purpose and interpret user intentions, he says.

"People today don't expect programs to do more than brute-force low-level calculation," Kaplan adds. "We want to promote them to problem-solving partners. Instead of saying, 'Put this number in that place,' you tell them, 'Make it the case that. . .'."

Kaplan defines AI as the process of representing concepts and ideas in symbolic form and reasoning about them. "As a technology, AI is a collection of programs, ideas, and tricks for processing symbolic information," he continues. That activity requires a language for stating intentions, Kaplan says. "When the language gets rich enough to express contradiction, all kinds of interesting things happen. There are 'intuitive' side effects."

The problem is tools. Though AI grew on VAX superminicomputers and specialized work stations that could handle large programs in Lisp and Prolog, the favored AI languages, Kaplan sees no difficulty in transferring the process to microcomputers. "The problem is tools, not processing power. There are no quality Lisp systems for microcomputers—not yet. But there are very good tools available for AI."

Kaplan, 33, is writing the Lotus application in Pascal on a rented IBM Corp. Personal Computer AT, the first personal computer he has ever used. He works at his Portola Valley home, set on a wooded hillside above the Silicon Valley smog line. He confers daily by phone with Lotus chairman Mitchell D. Kapor, and ships new code to Lotus's Cambridge, Mass., headquarters by overnight mail. The close collaboration with Kapor was part of the lure of forming the connection with Lotus.

Resourceful. "Mitch has superb instincts, character, and qualities," Kaplan says. "I enjoy interacting with him." Kaplan also enjoys the work-style trends at Lotus. "Lotus has an extremely flexible and tolerant approach to using resources."

Once a researcher in Stanford's computer science department and then a marketing and sales executive at Teknowledge, Kaplan became a software author on Kapor's advice. "I had never regarded writing software as a legitimate profession," Kaplan says. "It was like writing poetry—admirable, but you couldn't make a living at it."

Kaplan's current AI application will be complete enough by September for Lotus to decide whether or not to make it a product, Kaplan says. He hopes that it may also become the basis of a whole new category of software, in the same league with data bases, spreadsheets, and word processors. *–Clifford Barney*

Hanging loose. Jerry Kaplan works at home in a "loose" setup with Lotus and Teknowledge.

KURTIN LEARNS A MARKETING LESSON

Sun Valley, Calif.

For Stephen Kurtin, the lesson was clear: a product must be based on a consumer need, not simply on what is technically possible.

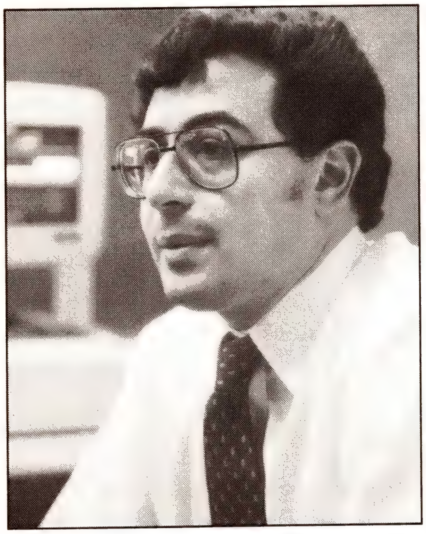
In 1972, Kurtin formed Lexitron Corp. with two partners whom he says "just had a notion, not a product. They had a computer architecture and didn't know what to do with it." He helped develop the Lexitron word processor and led the firm's sales efforts. Now Kurtin maintains the machine was "overspecified" with too many functions and priced too high for its market.

New approach. Lexitron was sold in 1977 to Raytheon Corp. and five years later, Kurtin joined with some new partners to form Protype Corp. This time, the firm based its product development on marketing surveys of office needs. From studies by such firms as Dataquest Inc., Protype saw the need for a product that combined the flexibility of an electronic typewriter with the power and efficiency of a word processor.

So the company developed the Protype Display Typewriter, billing it as a replacement for today's office typewriters. On the market about a year, it sells for $2,295 in a basic configuration. This model integrates a video screen with a standard electronic-typewriter keyboard and has a battery-protected 32,000-character memory. It has no disk drive.

Protype's president insists his company's product has no real competition and says that the closest machine on the market is the Xerox Corp. 640 Memorywriter. The latest model from Xerox, the 645 Memorywriter, sells for more than twice price of the basic Protype Display Typewriter but includes two disk drives, a keyboard, and a cathode-ray-tube display.

An 8088 chip does the processing on the Protype Display Typewriter, but the display processor, operating at 66 MHz, is a high-speed bipolar chip built from a Fairchild Advanced Schottky TTL. Variable clocking allows the display to show 10-, 12-, or 15-pitch typing.



Big plans. Protype president Stephen Kurtin sees a great future for his Display Typewriter.

At the National Office Machine Dealer's Association convention in Las Vegas July 10 to 14, Protype will introduce a firmware package, a disk drive, and a communications option for the Display Typewriter. With Firmware 3, the user can draw boxes for forms on the screen with function keys. The disk drive can read and write PC-DOS files. With a communications option, one Protype can exchange files with another or call up a data base such as the Source, or access a mainframe.

With a PhD in applied physics from the California Institute of Technology and a dozen patents to his credit, Kurtin has always been something of a technical whiz. At age 14, he earned a patent for his three-dimensional TV design.

His experience with that patent was an early lesson in marketing. RCA Corp. bid for the patent rights, but Kurtin's father turned it down. Color TV was then in its infancy, and Kurtin's invention worked only for black and white sets. Looking back now, Kurtin admits, recalling the title of a Woody Allen movie, "We should've taken the money and run." *–John F. King*

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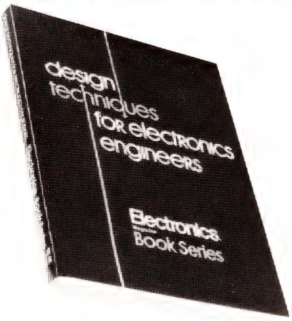

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DEVELOPMENT SYSTEM BREAKS PRODUCTIVITY BARRIER

Aimed at large-scale Ada software projects, incremental compilation replaces old technique

TECHNOLOGY TO WATCH is a regular feature of *Electronics* aimed at providing readers with exclusive, in-depth reports from companies around the world on important technical innovations. It covers significant technology, processes, or developments incorporated in major new products. The reports also provide analyses of technical data, so that readers can assess the impact of new developments. Paul Levy, president, and Michael Devlin, cofounders of Rational, led the team that did the work described this week.

Software projects, especially real-time defense efforts, are growing increasingly complex. As these programs cross into the realm of multimillion lines of code, today's development tools are falling ever shorter of the demands placed on them.

To meet the challenge of modern software engineering, an increasing number of manufacturers are marketing software development systems. Most often, these combine traditional editors, compilers, and debuggers into one package to support a team of programmers. Now Rational, Mountain View, Calif., has broken from the pack by designing special-purpose hardware and software for a new software-development system, the R1000 (Fig. 1). Aimed at speeding large-scale software development, the system caps five years' work at Rational, founded by U.S. Air Force Academy graduates Paul Levy and Michael Devlin and financed to the tune of $26 million by venture capitalists Arthur Rock and Hambrecht & Quist (see "Rational builds on patience of Rock," p. 39).

The R1000 supports Ada, the Defense Department's advanced programming language. Though Ada has had its ups and downs since its formulation in the late 1970s, a flurry of recent compiler introductions has won renewed support from the engineering community [*ElectronicsWeek*, Jan. 14, 1985, p. 20]. Most experts agree that Ada will continue to gain ground because U.S. defense contractors must use it and because the European Economic Community has adopted Ada as its standard.

The R1000 Development System's initial market will be aerospace and defense contractors, say Levy and Devlin. These companies will need to design increasingly complex large-scale real-time software. The U.S. space station project in the 1990s, for example, could run to tens of millions of lines of code. Though the demand for software is growing 20% to 25% annually, the number of programmers is increasing only 5% to 6% a year.

Conventional technology cannot deliver the improvements in productivity that would forestall a software-development crisis, Levy and Devlin warn. But they believe Rational's R1000 can modernize software development just as computer-aided engineering has revolutionized integrated-circuit design. Automating many detail-intensive and bookkeeping operations is the means to this end.

The key to the system's advanced performance is its built-in intelligence. The top level features automatic context sensing and switching. It obviates the need to shift up to the operating-system command level for access to each new tool—for example, editor, compiler, and debugger. Ada-like commands, instead of the specialized entries that conventional operating systems require, drive this cross-accessing feature. With windowing, multiple tasks can share the screen.

The system's editors perform Ada syntactic checking and completion. Besides reporting errors in user-entered program statements, they can automatically finish partly completed statements. And a DOD-validated Ada compiler offers a universal host. Users can execute programs on the R1000 processor or transport them to other target systems. Back-end compilers, which tailor the code for the different microprocessors used in embedded system applications, will be available for the R1000 in the future, the company says.

The R1000's heavyweight programming advantage, however, is its incremental compilation feature. This system makes the conventional, time-consuming, edit-recompile-debug-reedit cycle an anachronism. Instead, during debugging only new edits need be recompiled.

Adding just one statement to a 1,000-line program used to require recompiling the entire package. Morever, a true large-scale system will likely contain dozens of similarly sized programs. All this software must be recompiled—

1. Complete control. The R1000 software-development system from Rational features a dedicated processor and a terminal with a full-page screen.

which takes hours—for the complete package to work. So incremental compilation saves considerable time.

The R1000 also offers a software-management tool to decompose large-scale projects into manageable subsystems. This feature rigidly tracks the interfaces between subsystems and limits the use of common variables. So developers can build independent subsystems, and separately precompile and prelink them for later linkage.

Starting at a base price of $595,000, the R1000 comes equipped with a supermini-size computer, a user terminal, and a printer. The unit also houses power supplies, 1.9-gigabyte disk memory, a 1,600/6,250 bits-per-inch streaming tape drive, and input/output control equipment.

Double-barreled hardware

The R1000 processor builds on existing hardware technology, so it is more reliable, says David Bernstein, Rational's vice president of product design. Peripherals are off the shelf. A Digital Equipment Corp. PDP-11 is the I/O processor and service processor. The I/O bus meets DEC's Unibus standard.

"We treated circuit-board design like VLSI design," he says, noting the experience of Rational's six-member hardware group. The team constructed an extremely dense design consisting of eight-layer dual-edge-connector (a foreplane and backplane minimize wired connections) boards.

The processor designers' efforts focused on defining a run-time model of an Ada program, compared with classical architectural design where the instruction set's specification is most important. Bernstein explains, "What we've done is build a special-purpose engine for Ada."

The resulting architecture uses parallelism for more speed, especially the dual arithmetic-processing units in the central processing unit (Fig. 2). The CPU operates on 128-bit control words: 64 bits hold an arithmetic value, and a portion of the other 64 bits contain a pointer to a type descriptor. (Integer, Float, and String are Ada type examples.) When the CPU is running, control words are split. The upper 64 bits are routed to a value arithmetic unit, the lower to a type arithmetic unit. Thus type checking and addition, usually performed serially, can be done simultaneously.

The Field-Insertion Unit (FIU), another component of the CPU, offers additional efficiency. Hardware handles data packing and unpacking, which is usually controlled in software. In one step, the FIU reinserts and extracts the value, type pointer, and additional data bits from the 128-bit control words. The typical data-packing procedure of iterative shifts, ANDs, and ORs is greatly accelerated, particularly for the cumbersome example of non-byte-aligned fields.

The system's virtual-memory handler is another Rational hardware innovation, Bernstein says. The R1000 processor has four memory boards, each containing 32,000 pages of 1-K bytes, totaling 32 megabytes per board, and giving the processor 128 megabytes of physical memory. With a system address bus 67 bits wide, $2^{67}+1$ virtual locations can be addressed. Total storage on four Winchester disks is 1.9 gigabytes, unformatted.

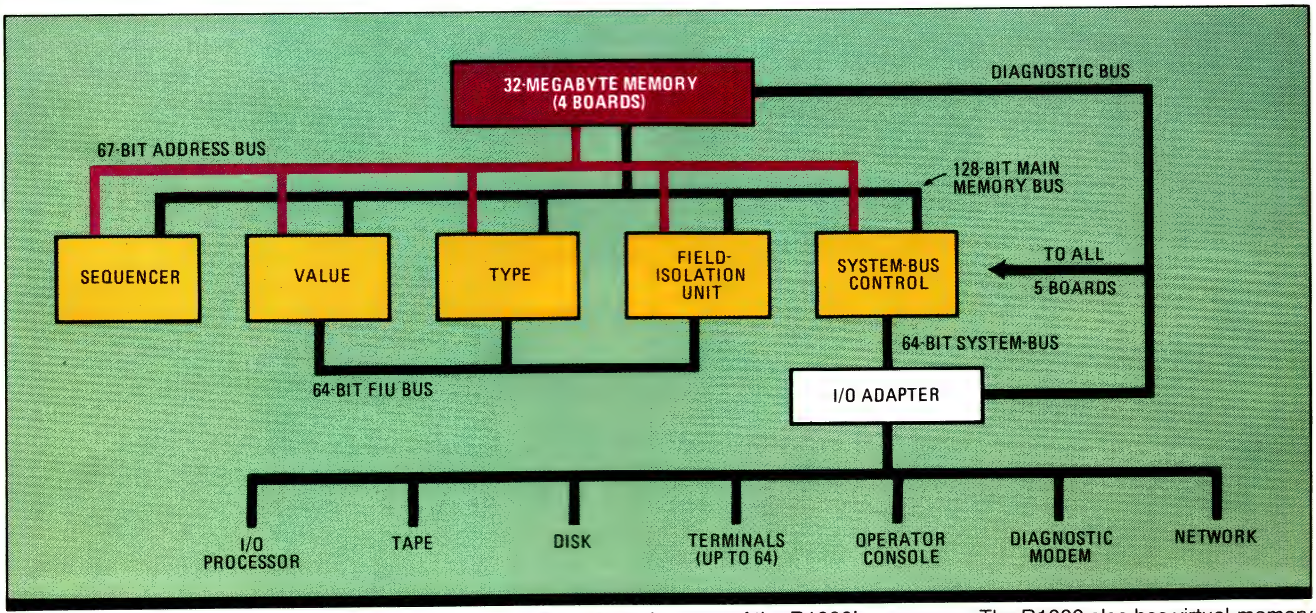
In the R1000, the swaps between disk and physical memory, and attendant task management are handled at the hardware and microcode level. This virtual-memory handling usually eats up considerable processing time with record keeping and I/O control. Operating systems traditionally manage virtual memory. The hardware and microcode approach, however, bypasses the interpretive system layers, which must be accessed by the operating system, and so gets closer to the heart of the machine. Thus it is faster.

A burned-out chip can quickly blunt the cutting edge of technology, however. So the R1000 has incorporated extensive on-board testing. Each CPU board has a separate microprocessor dedicated to monitoring board status. The information garnered by the test chips flows to a 128-bit-wide diagnostic bus. The data is used to test boards during manufacture, to save a diagnostic history on the system disks for maintenance, and to find faults for repair. An autodial modem completes the system. If the system fails, this unit can automatically download information from the customer site to the factory, so that service representatives can select the correct replacement boards before they make the call.

Streamlined operation

To realize the R1000, Rational's 18-member software team wrote 1 million lines of Ada code over three years. The internal complexity of its software design contrasts with the streamlined operation from the user's end. At the heart of the software is a core editor, an executive controller analogous to a traditional operating system. An important difference, however, is its automatic mode sensing and switching, using Ada-like commands entered by the operator.

The core editor invokes the specialized user tasks, which are handled by the succeeding layer of software in which a battery of object editors reside. The Ada object editor handles



2. Hardware. Dual arithmetic units—value and type—are important elements of the R1000's processor. The R1000 also has virtual-memory handling, bit packing, and diagnostic microprocessors on each board. Off-the-shelf peripherals enhance the system's reliability.

Ada programming tasks, including syntax correction and line completion. There are also text and command object editors.

The directory, crucial to the quick-recompile feature, and the standard compilation system are the next link in the software chain. The battery of object managers that follow provide a structure for permanent storage of programs, so that they can be executed and edited. Last comes the virtual machine. Consisting of software, hardware, and microcode, this handles virtual memory, I/O, and multitasking.

The R1000 supports its critical incremental compilation by building and maintaining a massive data base. This data base contains, for each user Ada program, that program's important attributes and characteristics. In rough terms, when the operator recompiles, the R1000 already has much intermediate information available and does not have to perform a full-blown compile.

A user enters an Ada program he has written into the R1000 by first typing the new program into the editor. As the program is entered, its name is stored in the directory. The R1000 begins to create a tree-structured representation of the program, similar to standarized Diana (for Descriptive Intermediate Attributed Notation for Ada), which lists all essential syntactic and semantic information for a given program.

To save the program, the user runs the compiler front end (shown as compilation system in Fig. 3). The program's initial tree representation is upgraded to a complete Diana model and stored in the directory. The stored data will contain explicit information on all variables, data types, and so forth in the program, including address pointers to the memory locations where these attributes are stored. The result is a huge data base. Rational estimates that for a fully compiled large-scale Ada package containing 6 million lines of code, a directory tens of megabytes long would be generated.

Incremental advantage

The system's full automation and power is apparent when the user recalls the program unit and tries to edit it. As before, automatic syntax checking and context switching as well as Ada statement completion are available. Now, however, the directory data base allows the R1000 to cue the programmer on the validity of his edit within the context of his full Ada software package. Will this change necessitate edits to other statements or data types in the current program unit? How about in the other 10, 20, or 100 program units in the system? The R1000 screen will display a list of dependencies, so that the programmer can upgrade accordingly.

After the user's changes, the updated program units are ready for their first taste of incremental compilation. The directory's data base again is important. For each program unit, rather than go through a full, lengthy recompilation, the R1000 performs what can best be described as automatic patching. Only the new statements (edits) are recompiled. They are then spliced into the program by altering a few pointers in the directory. The edits become, in effect, subroutines called from the original program.

Patching, which is usually performed by frantic programmers in a paper-strewn lab, has acquired a negative connotation. Often, the programmers work at a testing facility, under the deadline pressure of software integration. The down-time caused by the repeated need to recompile every time there is an edit is unacceptable. Frequently patches inserted during test (and the scraps of paper on which they are written) vanish later.

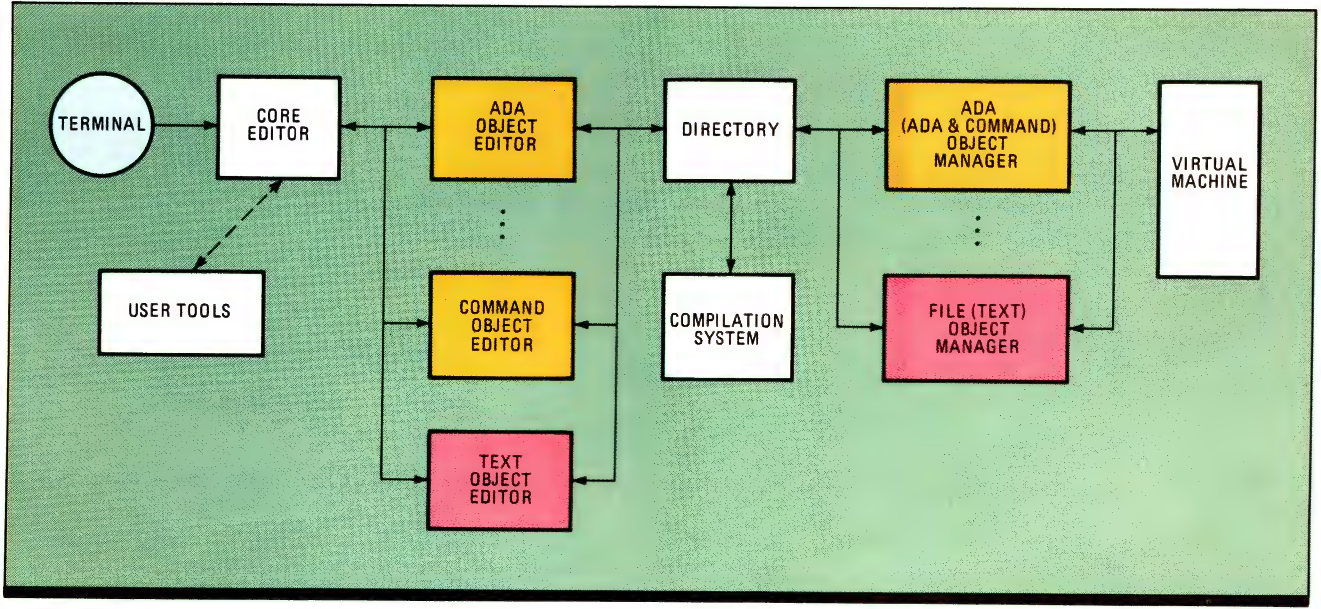
The R1000 elevates patching from a black art to a science. The operator can repeat incremental compilation throughout a lengthy debug or integration session because the system has memory to spare. Later, he can completely recompile the program units and the full software package when in-line object code is generated for the target processor.

Terms of performance

Rational software developer Brett Bachman quantifies the time saved with incremental compilation, compared with the traditional edit-recompile cycle. With a small software package of approximately 3,000 lines of code, the R1000 boosts speed sevenfold when modifying a statement. Adding a procedure or group of several statements is fivefold faster. Modifying a macro definition affecting all program units is 28 times quicker on the R1000. On a large-scale system of 100,000 lines of code, Bachman estimates savings of 18, 6, and 86 times, for the three activities above.

Reports from the field are beginning to filter in. Lockheed Missiles & Space Co. is beta-testing the system at sites in Austin, Texas, and Sunnyvale, Calif.; Rockwell International's North American Aircraft Operations facility in Lakewood, Calif., is another beta-test site.

At Lockheed, Rational's system is being compared with several alternatives, include one containing Digital Equipment Co.'s VAX-based Ada compiler. (DEC's compiler, introduced last fall, has made a big splash in the Ada market.)



3. Objectified. Separate object editors and managers highlight the R1000's modularized software design. Crucial to the system's novel incremental compilation feature is its directory, which maintains a tree-structured Ada program representation.

A big booster of the R1000 is Win Royce, director of Lockheed's Software Technology Center in Austin. "I believe a machine that is expressly tailored to the problem of Ada production is needed—I expect the R1000 to outperform general-purpose machines." Lockheed is trying to generate 12,000 lines of code on the system in six to eight months, instead of the two to three years the job usually takes.

Royce reels off a list of system pluses his staff favors: incremental compilation leads, followed by the automatic switching between modes, syntax checking and Ada statement completion, use of Ada-like commands, and compiler speed. But the R1000 is not for the novice, he warns. "It's a hard system to learn, but the power it brings to the individual programmer is breathtaking." ☐

COMPANIES

RATIONAL BUILDS ON PATIENCE OF ROCK

When U.S. Air Force Academy graduates Paul Levy and Michael Devlin needed backing for their planned software company, they knew exactly where they wanted to go. Levy, president and chief executive officer of Rational, and Devlin, who as engineering vice president conceived the R1000 work-station architecture, wanted fabled venture capitalist Arthur Rock behind them. "By his reputation, we knew him to be the preeminent source of capital for people with Rational's objectives," says Levy. "It was the best decision we've made."

The way Levy tells it, the twosome got an appointment with Rock, but during the entire three-hour presentation, Rock uttered not a word—not a question, nothing. Levy laughs about it now. "Arthur does not give one an enormous amount of feedback," he says. "I suppose someone in his position has found it more effective to listen than to talk."

Founders. Paul Levy (right) and Michael Devlin aim Rational's R1000 at boosting productivity of big-system programmers.

The next day, Levy delivered some additional material to Rock in San Francisco and they spent a two-hour lunch talking "mostly about personal motivations. At the end of lunch, he agreed to give us the money. In my estimation, he's as much a founder as Mike and I." Rock is now chairman of Rational's board of directors.

The unveiling of the company's Rational 1000, a new hardware and software tool for large-scale software development—caps an intense, five-year development program. It is testament not only of the drive of the two founders but also of the extraordinary patience of Rock and fellow San Franciscans William Hambrecht and the late George Quist, the principal investors who by June 1983 had put up $26 million.

Levy, 29, and Devlin, 30, were best friends and fellow high-achievers at the Air Force Academy in Colorado Springs (both first in their class in respective majors—business and economics and engineering and computer science). While working together at the Satellite Control Facility in Sunnyvale, Calif., they thought of their Ada-based products. They both went on to earn masters degrees at Stanford University. Devlin earned his in computer science, Levy in a combination called engineering economic systems—halfway through his engineering degree, he decided to start the company and dived into business courses.

Same strategy. The business plan Levy and Devlin showed Arthur Rock back in 1980 was exactly the one Levy wrote for his new venture-management class in the spring of 1980 and "the strategy hasn't deviated one iota since then," Levy declares. He recites it from memory: "To be a computer-aided-engineering company whose products and technology would enable teams of people designing, manufacturing and developing software systems to do so more effectively."

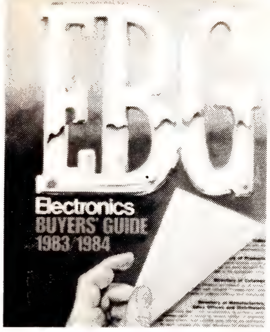
Personal motivations are an important topic to Levy. Intense and driven, he believes in a corporate culture where everyone shares in the fruits of creation. David Bernstein, 33, vice president of product development, says the acculturation for this type of team effort is critical. "Some people joining the company had to talk to 50% to 80% of the others as part of the development process. The product has always been considered a company project," he says. "We still have a Thursday meeting and dinner for the entire company each week, and have had them since T=0."

The photograph of Devlin and Levy with the product (below) is a first—until that day, Levy explains, they refused to pose in front of the machine because "it was a collective effort, and we didn't want to take the credit for it."

If the product is a success, whoever takes the credit will be applying it toward a huge potential market: the aerospace industry. Paul Cubbage, senior industry analyst for Dataquest Inc., was the only analyst to see a demonstration of the $595,000 Rational system, and he foresees vast potential in the aerospace industry. "They've built as good a tool as it's possible to build. And yes, I think it will reduce [software-development] costs."

Those costs as predicted now are astronomical: Cubbage says by 1990, the Department of Defense will have a computer budget of $45.8 billion, and software will make up $36.7 billion of it. On how much Rational will improve that ratio, he says, "the proof is in the pudding. But I'm very bullish on the technology."

Rolm Corp. and Data General Corp. have already li-



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censed the Ada compiler for $4.5 million, and beta-test sites are already in place at Lockheed Corp. and Rockwell International Corp., which paid full price for them. Levy says that in the next 18 months such companies "will be our most significant contribution," allowing the company to gain concentration and critical mass. So far, Lockheed, gives the R1000 and Rational rave reviews.

Says Tom Arkwright, head engineer at the company's Ada Technology Support Laboratories in Sunnyvale, the system for which Lockheed paid close to $1 million has already helped it win three contracts since delivery in mid-February. Mark Sutton, head of the Rational beta-test project for Lockheed, reports that the R1000 "blew the competition away" in a 1,000-line demonstration matchup against another system involving data entry and compilation.

Levy does not, however, expect that defense-related industry will always be the main users of Rational's system. He hopes that Fortune 1,000 companies that want to get both hardware and software products to market quickly will find advantages in using Rational's system. Cubbage is not so bullish on this idea, however.

'We want to push to be 5% or 10% better than we're capable of'

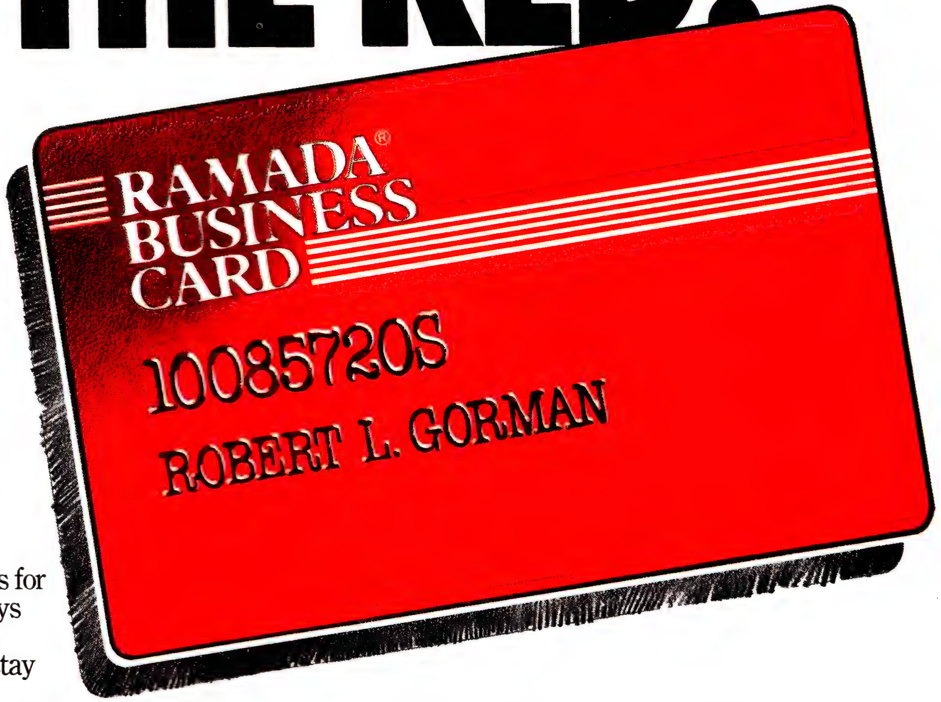
"I don't think the Fortune 1,000 market cares beans about Ada," he declares. [Rational] will have to do a lot of missionary work to make that happen."

But missionary zeal is what Levy is all about. After all, Rational is his first real-world job—he went directly from high school into the Air Force, from the Air Force to Stanford, and from Stanford directly into founding the company, with two $100 checks—his and Devlin's.

"We're passionate about what we do," says Levy. "If we're investing ourselves, we always want to push to be 5% or 10% better than we're capable of. You find you never achieve anything anywhere near your expectations. In 10 to 15 years, we want to build one of the most significant technology companies in the United States and have a fundamental effect on quality of life for the people who work for us. That is some reason to live, and that's what it's all about."

But Dataquest's Cubbage thinks growth of that magnitude will put Levy to the test. "He is the classic president of a high-tech startup. They've been terrific on technical design and strategy. It remains to be seen if a company with that personality can do the growth things." *–Denise Caruso*

THE ADVANTAGES OF BEING IN THE RED.



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IC PRODUCTION LINES MOVE CLOSER TO FULL AUTOMATION

by Jerry Lyman

ROBOTS, GUIDED VEHICLES, STANDARD INTERFACES, AND COMPUTER NETWORKS POINT TO HIGHER CHIP YIELDS

Despite an ongoing recession, the integrated-circuit industry is in the midst of serious changes driven by the need to cut costs and raise yields of current and future very large-scale ICs. IC production is moving from its current phase of semiautomation toward almost full automation of the entire manufacturing process, including assembly and testing. The goal is to remove people—the major source of circuit-killing particulate matter—entirely from the process.

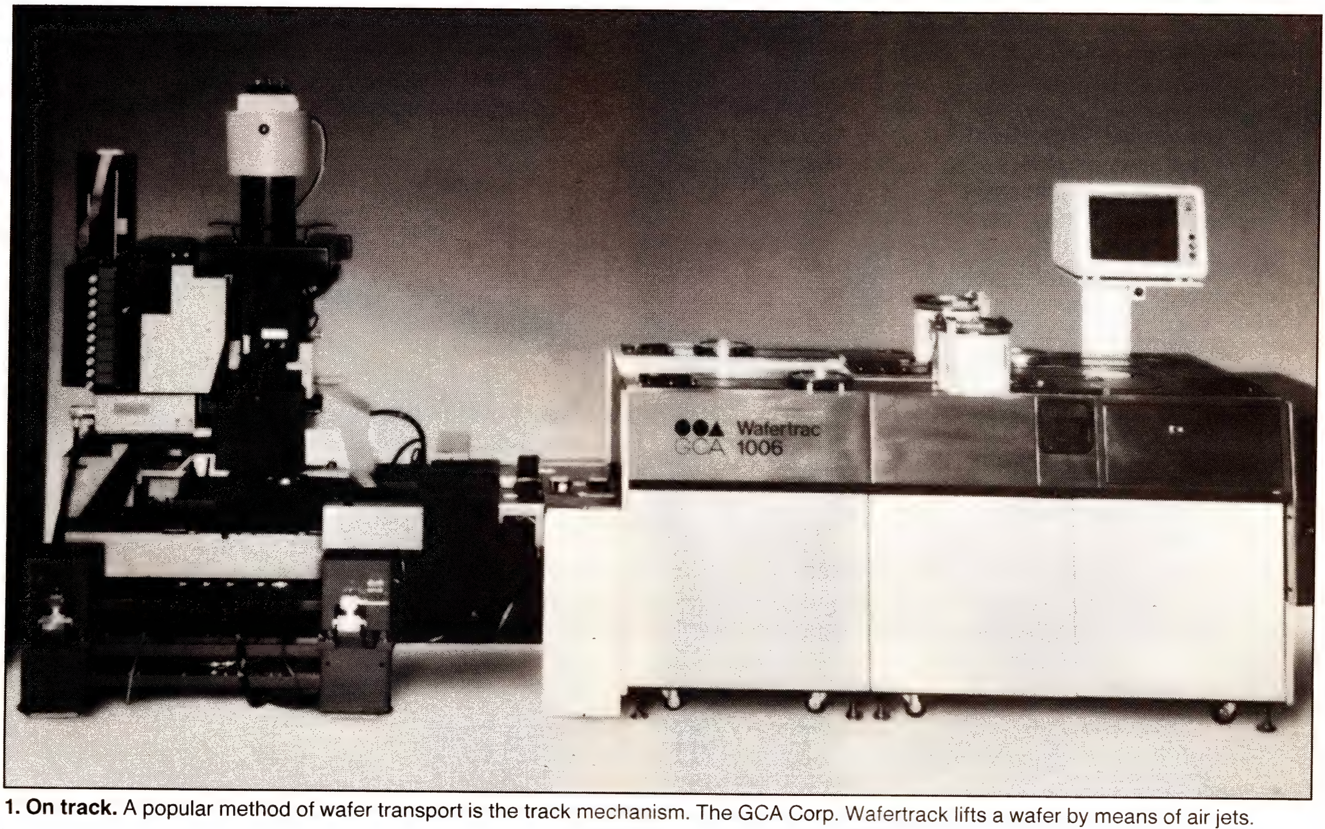
This is an evolutionary step that will automate the basic tools of IC processing and wafer-handling as well as tie together all aspects of IC production in a computer-integrated-manufacturing network.

By now the basic tools of IC processing—the lithographic, etching, and sputtering equipment, diffusion furnaces, and ion implanters—are almost fully automated. Optical lithography in particular is now heavily automated. Many commercially available systems, such as the Wafertrack (Fig. 1) from GCA Corp., Bedford, Mass., link all the lithography process's major steps—cleaning, coating, baking, alignment, exposure, development, and curing—in compact systems that move wafers on a track connecting all the major modules of the yellow (lithography) room. Each module can have an individual controller that talks to a host controller.

In the critical field of dry (plasma) etching, the latest machines, whether for single-wafer or batch processing, are completely automated with a built-in microcontroller and an interface to a host computer. Single-wafer machines such as the Omni-Etch 20,000 from Perkin-Elmer Corp., Norwalk, Conn., are fed wafers from a track transport or in a cassette-to-cassette operation in which unprocessed wafers are fed into the etcher and processed wafers exit in a cassette.

Automating a batch-etching system requires the use of either a robot or a built-in mechanism to transfer wafers from a cassette into special trays mounted in a six-sided processing chamber. The model 8300, the latest batch etcher from Applied Materials Inc., Santa Clara, Calif., is totally automated; all its operations take place in a vacuum. This makes for a high-throughput, low-particulate machine.

Inside the 8300's vacuum chamber, a three-axis robot removes wafers from a standard cassette and places them in cavities in the system's hexode chamber. At the end of an etching cycle, the robot removes the wafers and places them back in the cassette.



1. On track. A popular method of wafer transport is the track mechanism. The GCA Corp. Wafertrack lifts a wafer by means of air jets.

The latest generation of sputtering machines is almost at the same level of technology as the dry etcher. The problems are also similar: automatic handling of wafers and cassettes, process monitoring and control, and electrical and software interface to the local and host computers.

Automated wafer loading into sputtering systems from cassettes takes several forms. Hard automated systems for silicon wafers have been on the market for a number of years. Multiple cassettes on a single system reduce the number of times an operator must return to the system for loading. A minimal-complexity system is the model 202 (Fig. 2) from Materials Research Corp., Orangeburg, N.Y., in which wafers are returned to the same cassette after sputtering.

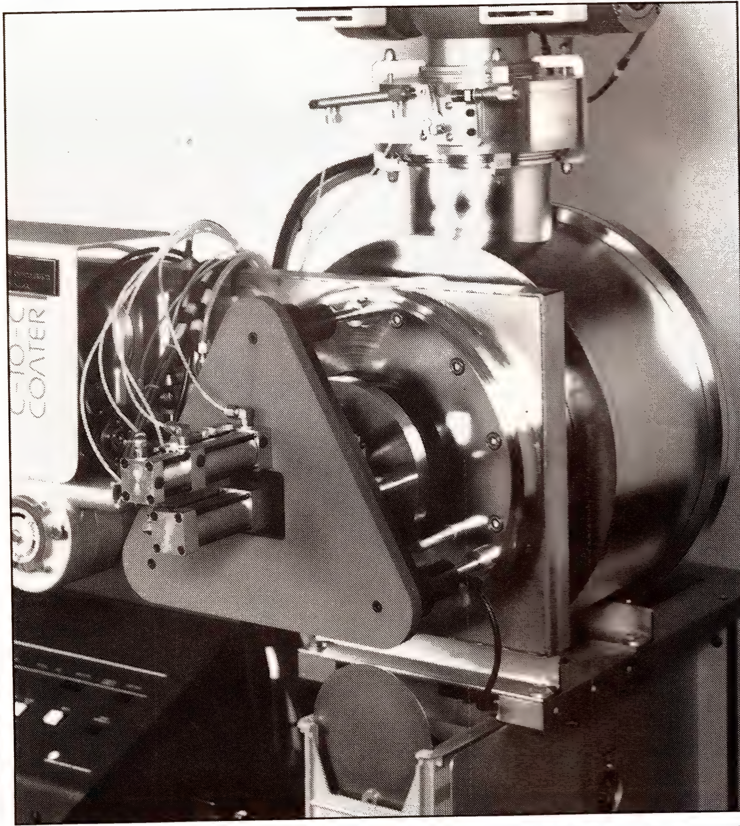
A more recent sputtering-system approach is the flexible automatic handling of different-sized substrates by robots to maintain a low particulate level. For example, on Materials Research's model 662 (Fig. 3), a robot handles silicon wafers ranging in size from 2 to 6 in. The robot is a PRI 1000 designed by Precision Robots Inc., Woburn, Mass., for clean-room service: it sheds 10 to 20 times less particulate matter than a human operator. A flat vacuum wand removes wafers from a cassette. The robot vertically orients the wafers and places them on a pallet in the sputtering system.

Automating the furnace

The diffusion furnace is one of the last IC-processing stages to be fully automated, a result of the complex wafer-handling process that the horizontal diffusion furnace requires. In this type of furnace, a wafer must be taken from a standard plastic cassette and transferred to a slot in a special quartz carrier or wafer boat. This carrier in turn must be inserted onto a paddle (quartz or silicon carbide) in a quartz tube and guided into the heating chamber. After processing, the whole procedure must be reversed.

Typical of the next generation of diffusion furnaces that will completely automate the loading and unloading of process quartzware is the Bruce Systems line from BTU Engineering Corp., North Billerica, Mass., which was shown at the recent Semicon West in San Mateo, Calif. (Fig. 4).

2. Wafer handling. Materials Research Corp.'s model 202 sputterer transfers single wafers from a cassette (bottom center) to a chamber (center) where wafers are processed singly.



In this system, the operator or a robot moves cassettes loaded with wafers through an input port. Inside, a mechanism or robot automatically transfers the wafers to the quartzware. The loaded boat is then moved into position and picked up by an elevator system that feeds the adjoining diffusion equipment.

After processing, the wafers are returned automatically to their cassettes in exactly the same positions in which they arrived. The cassettes are then held for removal at an output port.

Boats only

Another feature of the Bruce system and of practically all new furnaces is a boats-only soft-landing system. This system automatically loads and unloads the furnace tube with a vertically movable cantilever paddle and an automatic tube-closure mechanism. The paddle carries wafer boats having special soft-landing feet into the tube, lowers them gently until the tube is supporting them, and then withdraws. When processing is complete, the cycle is reversed.

This transport system reduces particulate generation by eliminating the sliding or rolling characteristic of wheeled paddles during insertion and withdrawal. In addition, it extends paddle life, speeds diffusion-equipment response, and saves energy by reducing the thermal mass of the paddleless cassette.

An interesting variation on diffusion furnaces is the vertical type made by only two companies, Disco-Sier USA Inc., Plano, Texas, and Tempress, a unit of General Signal Corp., Santa Clara. Disco-Sier offers an existing unit; Tempress has a brand new one.

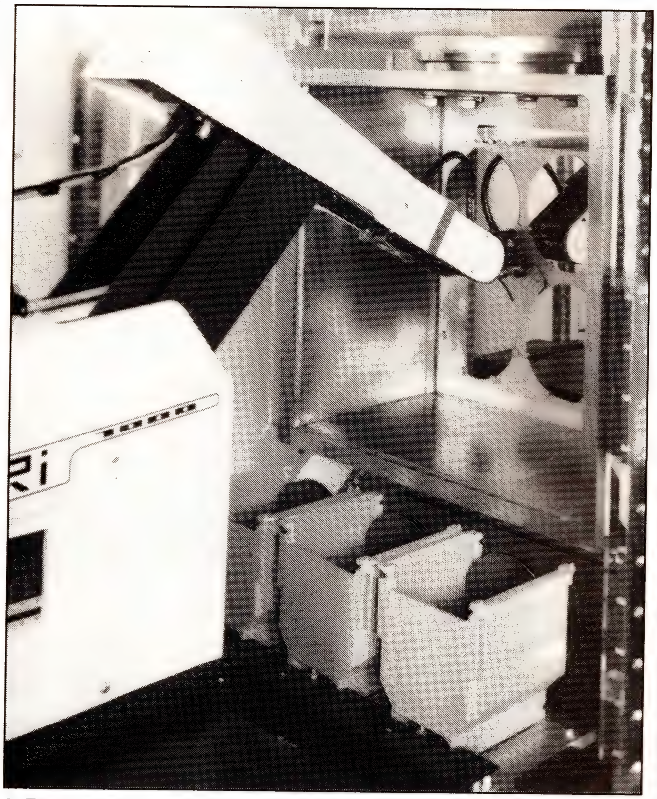
In this type of furnace, a robotic arm transfers wafers from a standard cassette to a vertical quartz carrier on an elevator that moves the cassette vertically into the furnace. In the Disco-Sier unit wafers travel downward; in the Tempress unit they travel up into the system's furnace chamber.

The vertical unit eliminates the quartz-to-quartz contact of the horizontal types as well as the need for soft landing systems. Its simpler robotics and horizontal transfer of wafers reduce clean-room space. Horizontal furnaces already dominate wafer-fab facilities in the U.S., but vertical furnaces are starting to show up as well.

"Until recently, the tweezer or hand-held vacuum wand was the preferred wafer-handling technique for servicing most front-end process and inspection machines," notes Brian Hardegan, product engineer at Brooks Automation Inc., North Billerica. Because wafer sizes are increasing as geometries decrease, these industry practices have had to change dramatically in recent years.

Silicon-wafer manufacturing and front-end clean-room standards have generally increased by an order of magnitude, and human operators have been identified as a major source of contamination. Larger wafers are heavier, more valuable, and therefore more difficult to transport. As a result of all these factors, Hardegan and most industry experts conclude that automated wafer transport is an absolute requirement on the IC-processing line.

Several years ago, observers thought that wafers would be moved from process step to process step by track mechanisms such as belts, air jets, or walking beams. Although IBM Corp. has built such a line—known as Quick Turn Around Time or QTAT—at its East Fishkill, N.Y., facility, this technology has never



3. Robot fed. Robots provide flexibility in handling wafers of varying sizes. A Precision Robots Inc. model 1000 robot puts 6-in. wafers into the chamber of a Materials Research sputtering system.

completely caught on. It is used most extensively for linking process modules in the lithography process.

What seems to be evolving instead is a form of automated cassette transfer that feeds single wafers serially to islands of automation. This can be done in any of four ways.

Clean-room workers generally do the direct transfer; in some cases, a multiaxis robot has sufficient placement accuracy and lifting capability. The cassette-bus concept offers increased system flexibility for routing to various process stations by transporting individual cassettes within a "clean tunnel." In-process cassettes of wafers are placed onto a vehicle that delivers them to the appropriate station, where a bar code reader identifies them and the resident robot transfers them to the next process.

The cassette shuttle is flexible. As with the bus system, a dedicated robot at each process station must transfer the cassettes to and from the tunnel.

Using sealed containers, clean-room personnel can carry the in-process cassette between work stations without significant contamination of wafers en route.

In the direct transfer of cassettes, GCA has demonstrated an extended-reach gantry robot that transfers a wafer cassette from a GCA stepper to a GCA triode etcher within a clean room.

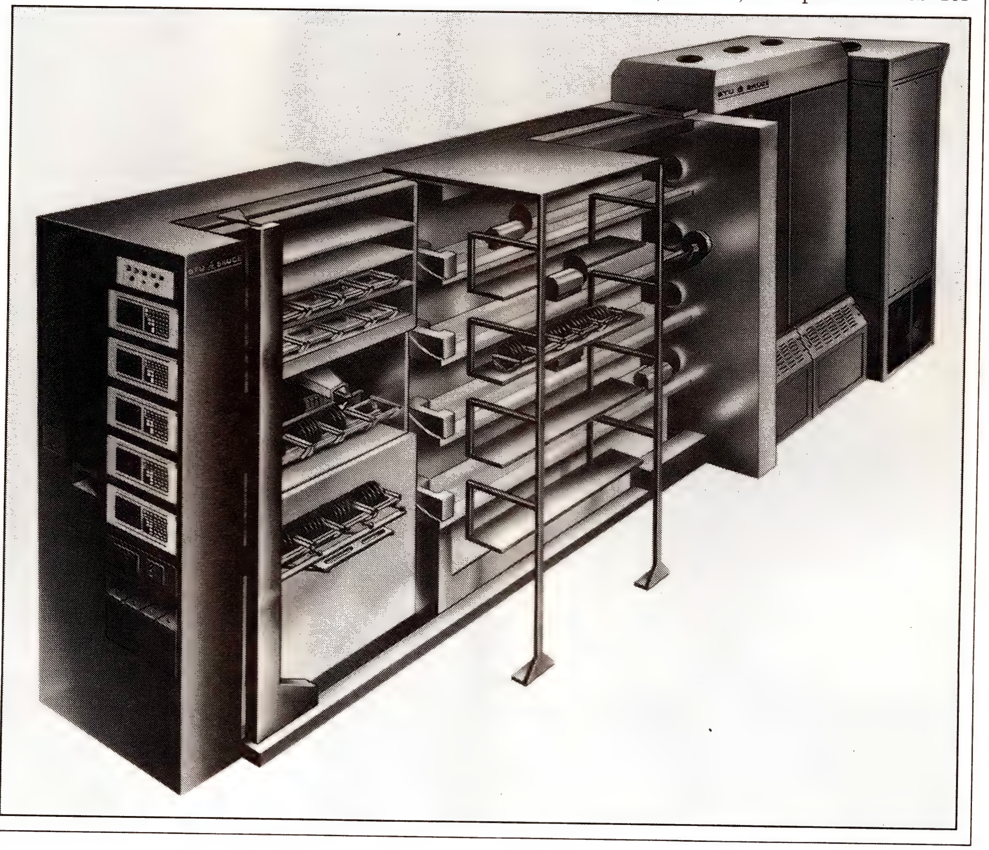
The bus concept, combining automatically guided vehicles with a built-on robotic arm for transferring cassettes, may be most likely to succeed. Currently, Veeco Integrated Automation, Dallas, and Flexible Manufacturing Systems Inc., Los Gatos, Calif., make this type of equipment. According to James Harper, president of Veeco Automation, the Japanese are heavy users of guided vehicles in wafer fabrication but without built-on robotic arms.

Guided vehicles

Veeco is the U.S. leader in this field with three types of vehicles: the V1, with no robotic arm; the V2, with a four-axis arm; and the V3, with a seven-axis arm for loading and unloading process machines. The Veeco vehicles, designed to work in a clean room, navigate by following a fluorescent paint or tape pattern on the factory floor and are commanded by an infrared communications link. The firm has already sold systems to Fairchild Camera & Instrument Corp., Mostek, and the Siemens/Philips joint VLSI venture.

Flexible Manufacturing's transport vehicle (Fig. 5) has a six-axis Intelledex robotic arm and is controlled by an IR communication link. It uses sonar for collision avoidance and does not have to be constrained by the taped pattern; it can be moved in a more flexible manner by means of a gyro-based inertial navigator. Flexible Manufacturing's goal is to achieve a 1,000-h mean time between failures with this vehicle. This company's first delivery will be to a large telecommunications firm in Florida.

Another strong contender in cassette-transfer technology is a technique developed at Hewlett-Packard Co., Palo Alto., just last year—the Standard Mechanical Interface, or SMIF, now being made at Asyst Technologies Inc., Fremont, Calif. SMIF systems (Fig. 6) involve small, sealed, dustproof boxes for



4. Happy landings. A new Bruce Systems diffusion furnace delivers wafers from cassettes to quartzware and then returns them to their identical cassette positions after processing is complete.

storing and transporting wafer cassettes. Each box has a specially designed "door" and each enclosure or canopy surrounding the equipment has a mating door. This mating arrangement is the Standard Mechanical Interface. The environment inside this enclosure or canopy is, in effect, a miniature clean room.

In transferring cassettes, the two doors open simultaneously, trapping particles that may have been on the outside surface of either door in the space between them. The equipment must be fitted with a special mechanism that operates the doors and transfers the cassette between the box and the equipment's indexer. This transfer has to be performed so that the external environment does not contaminate the wafers.

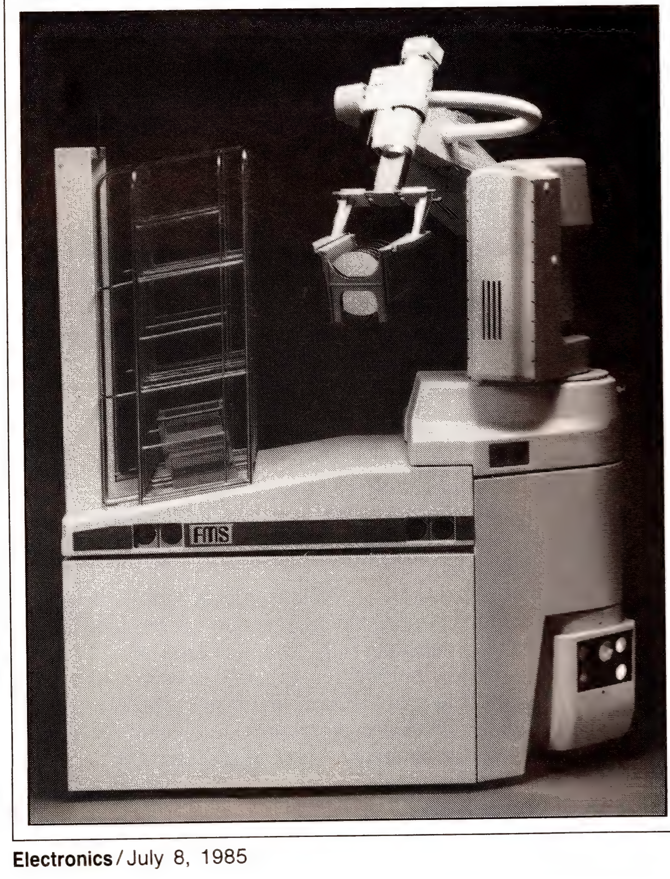
The SMIF system is flexible because either human or robotic operators can transport its boxes. HP has demonstrated particle reduction by as much as 10 times that possible in a conventional clean room.

A recent variation of the SMIF system involves SMIF boxes and a special-purpose robotic mechanism interfaced to a stepper. SMIF mechanical interfaces have already been designed into semiconductor-processing equipment from MTI, Tylan, and GCA.

If all the equipment in a yellow room is put under individual enclosures, each with a locally controlled environment of Class 10 or better, it is possible to run the room overall at a Class 1000 level. This full SMIF implementation can significantly reduce space and energy consumption. For example, it would be possible to reduce the 250,000 ft^3 of space in a typical clean room to 2,500 ft^3, with the concomitant cost and energy savings.

Automation by itself is insufficient to get to the overall objectives of high yield, low costs, and increased productivity. A modern semiconductor facility needs a computer-integrated-manufacturing network to manage, monitor, control, collect, and interpret data, and to link all elements of the fabrication process with a communications network. Thus, a whole new CIM software and hardware industry has sprung up just to support IC production.

5. On the move. Guided vehicles such as the FMS mobile transport vehicle, will shortly be carrying cassettes of wafers between processing tools on automated IC fabrication lines.



The main players in this new industry are I.P. Sharp Associates, Toronto, Ont., Canada; HP; Sentry/Schlumberger Computer Integrated Manufacturing Systems, Los Altos, Calif.; Consilium, Mountain View, Calif.; and CTX International, Sunnyvale, Calif. Some newcomers are GCA, Isitec Corp., BTU Engineering, and Kulicke and Soffa, which has a CIM system for the assembly end of an IC line.

I.P. Sharp's CIM software is called Promis and was developed under a joint effort by the Canadian company and General Electric Co.'s Solid State Operation. It is currently installed at 16 companies worldwide. Promis uses a distributed-systems architecture, with microprocessors performing the front-end facilities-monitoring functions and a Digital Equipment Corp. VAX computer to coordinate control of the entire manufacturing process. The Semiconductor Equipment Manufacturers Institute's Semiconductor Equipment Communication Standard 1 and 2 communication protocol links the processing equipment to the host computer.

Promis cuts paperwork

Silicon Systems Inc., Tustin, Calif., a custom and semicustom IC producer, has been running Promis for three years with a dual VAX setup and more than 40 terminals. Currently, the CIM software is eliminating paperwork and is controlling diffusion furnaces and automatic test equipment as well as specifying recipes. Future plans are to interface the facilities-monitoring software to lithography-inspection equipment. "We feel process problems picked up by this system have paid for the cost of Promis," emphasizes Larry Cleland, manager of manufacturing systems planning at Silicon Systems.

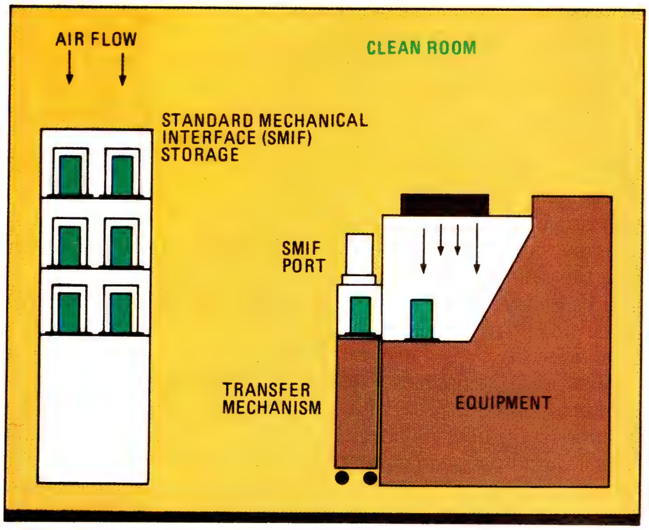
Hewlett-Packard's CIM system is called the Semiconductor Productivity Network (SPN), developed as a distributed-computer network installed to control one of the firm's IC facilities (*Electronics,* June 5, 1980, p. 151). The SPN is based on two HP computers, the models 1000 and 3000. The 1000 supervises real-time equipment functions while the 3000 performs transaction-processing functions and data-base management. Usually, multiple HP 1000s are networked with a central HP 3000. HP has 10 software modules, including a TC-10 tester collection system, a PC-10 process-control system, and PL-10 production-planning system.

Hewlett-Packard has 34 customers using SPN at more than 90 sites. One of the largest is Intel Corp. The Santa Clara firm has realized significant improvements in product yield with computerized data collection, tracking, analysis, and control systems designed for the semiconductor industry. Intel is installing SPN software to run on HP 3000 computers located in its eight semiconductor-wafer-fabrication facilities and five assembly-and-test facilities around the world.

The SPN system has already made a difference at Intel's beta-test site. Early in 1984, a process engineer made an adjustment on a mature product—a mask critical-dimension target change—and managed to increase the product sort yield by 10%. Robert B. Clifford, Intel's manager of components data automation, estimates that this slight adjustment paid for the plant's entire system, both hardware and software, in just four months.

Sentry/Schlumberger's entry into the CIM arena is called Incyte II. This is a complete CIM package for fabrication, assembly, and test built around a VAX. It has its own local-area network based on Ethernet and completely supports the SECS protocol.

The CIM network can cover the entire semiconductor production flow from silicon-ingot growth to assembly and final test. Incyte is installed at 12 Fairchild Semiconductor sites in North America and Europe and has led to 5% to 7% improve-



6. SMIF. The Standard Mechanical Interface concept isolates the wafer during storage and transport. Particle-free SMIF boxes are transported to special SMIF transfer mechanisms that send the cassette into equipment with special enclosures.

ments in yields; cycle times dropped by 23%, and products needing rework declined by as much as 30%.

Consilium's software, called Comprehensive Online Manufacturing and Engineering Tracking System (Comets), is also based on a VAX and uses the SECS protocol. The Palo Alto firm's software package includes 12 modules for such functions as work-in-progress tracking, engineering data collection, nonlot tracking, data analysis, factory communications (for a paperless environment), process-automation management, facilities monitoring, capacity planning, and scheduling.

For the past year and a half, Harris Semiconductor Corp., Melbourne, Fla., has used two Comets software systems to control a diffusion furnace and a lithography inspection machine. The CIM software has reduced lot-traveler records (paperware that moves with each discrete lot) from 20 pages to 1 page—an almost paperless operation. It is still too early to gauge the system's effect on yield and costs, but Harris's CIM experts find that the software's wafer-tracking and record-keeping features have minimized scheduling problems.

With the exception of Incyte, all the above IC CIM systems do not deal with the assembly end of IC production, which consists of wafer preparation and dicing, die bonding, wire bonding, encapsulation, and testing. At Semicon West, Kulicke and Soffa Industries Inc., Horsham, Pa., introduced a factory-automation system called the Semiconductor Assembly Management System to fill this void. Its goal is to increase the productivity and quality levels of semiconductor assembly.

Three-tier architecture

Kulicke and Soffa's network has a three-tier architecture that distributes intelligence from the machine level through data concentrators and up to a central factory host computer. The lowest tier of the network is the peripheral communications controller, a single-board computer designed around a Motorola 6809 processor. Each assembly machine in the automation system needs its own peripheral controller. Operating under SEMI's SECS protocol, these boards transmit data to the higher-level system through RS-232-C ports. Error codes, bond tables, wafer maps, machine processing data, material identification, and tracking information can be communicated through this system.

At the system's middle level, an intelligent data concentrator consolidates the information received from a group of machines. The concentrator is a DEC MicroVAX or equivalent, which can support up to six pieces of assembly equipment. The concentrator then communicates information to the system's uppermost tier, which is the factory floor controller, over Ethernet.

The controller can range in size from a DEC VAX 11/730 to a VAX cluster. The controller in turn can interface with a higher-level management information system. This host would provide overall scheduling information, data from prior assembly operations or wafer fabrication, and the basic coordination for the overall assembly operation.

The real thing

Although all the basic tools of the technology are now available, with the exception of IBM's QTAT line full automation of IC-production lines in the U.S. is just beginning. But it could halt for a while: the current recession has caused cancellations and delays of many planned automated facilities. Japan is much farther along in full IC-processing automation.

In their Semicon West paper on the impact of process automation on VLSI-chip yields, Masakatsu Nakamura, Kanro Sato, and Yasuske Sumitomo of Toshiba Corp. define three stages of IC automation.

The first is automatic operation of main equipment in the cassette-to-cassette mode with an automatic operation sequence using microcomputer control. The second is local inline systems for main processes, automatic wafer handling and transportation, and local computer networks for process and lot control.

The third stage of IC automation connects processing areas by means of vehicles and automates the transfer from one piece of equipment to another by robotics. It also automates visual checks of geometry, cross sectional structure, particle density and other physical parameters, as well as links complete computer networks for process and production control (CIM).

Currently, most U.S. firms are still in stage one, with many already having the computer network of stage three. In general, stage three is only in the planning stage.

In Japan, many companies already are at stage three. Toshiba is one of the few that will talk about its system in detail.

Toshiba has developed a new computer-aided-manufacturing technique that approaches stage three. The technique's main purposes are production control and quality control. The line includes a computer network for production and process control, in-line systems for main proceses, automatic wafer handling, automatic transportation, and monitoring systems for particle detection.

Toshiba's CIM network uses a three-layer hierarchy. The top layer consists of a host computer for managing the whole system. Next comes a block computer, which manages communication between the host and the bottom layer of machine controllers. Communication between block and machine controllers is standardized using the SECS protocol.

Toshiba uses an automatic transportation system that carries a load of wafers from one process room to another. This system is controlled by the block computer, which gets its destination commands from the host. Transportation between rooms is by a monorail vehicle that hangs from the ceiling and passes above all other equipment. (There are elevators at each station.) Switches in the overhead rail direct vehicles to different destinations.

Automation brings its own problems along with its benefits. Toshiba's Nakamura, senior manager in the Integrated Circuit Advanced Process Engineering Department, IC Division, notes that mechanical automation can replace some handling operators but not the maintenance engineers who bring in a lot of contaminating particles. Therefore, equipment with high reliability and short maintenance time is essential for an automated plant. Toshiba's solution is simple structured equipment with primarily modular parts. □

CIRCUIT AND LOGIC SIMULATION GETS FASTER AND BETTER

Conference highlights software systems that cut costly computer time

Circuit and logic simulation, a godsend to engineers who once labored by trial and error to produce working IC prototypes, is coming of age. Once, such simulation software programs as Spice were bulky and inefficient, and they possessed insatiable appetites for expensive computer time. But the latest developments in computer-aided engineering and design, which premiered at the Design Automation Conference in Las Vegas June 23, display great gains in speed and efficiency.

The greatest leaps have come in simulation accelerators that cut deeply into the mass of computer time once needed to perform simulation tasks. Slow processing and its related high costs kept many companies from simulating circuits as thoroughly as possible. But accelerators now coming to market should make simulation more affordable.

A leader in this technological breakthrough is Weitek Corp., which developed the Spice Accelerator. This add-on system, the company says, can boost some work stations' run speed by 10 to 40 times over that of a Digital Equipment Corp. VAX-11/780 with a floating-point accelerator. The three-piece Multibus board set combines custom VLSI floating-point technology with CSpice, a Spice software package optimized for floating-point acceleration by Circuit Tools Inc., San Ramon, Calif.

Weitek used microcode for the computer-intensive portions of the Spice calculations so they could be run directly by the three-board hardware. This frees the host for other tasks and provides maximum performance. The board set balances the floating-point acceleration of each part of the simulation process, regardless of the size of the problem, the company says.

Time-consuming jobs. Essentially, Spice has two major tasks that require extensive CPU time—the evaluation or setup phase and the sparse matrix equation-solving phase. The more complex the circuit being simulated, the greater the amount of time spent on equation solving. Because time consumed on the two steps differs proportionately with complexity, systems without the Spice Accelerator's ability to spread out acceleration resources according to the needs of a specific problem generally cannot record comparable efficiency gains on complex circuits as they do with simpler designs.

The board set, which has a peak throughput of 16 megaflops in double precision, has 4 megabytes of data memory, expandable to up to 16 megabytes for applications involving very large problems. The addition of a second WTL 1065 arithmetic logic unit doubles the speed to 32 megaflops.

The Spice Accelerator runs on general-purpose work stations such as those by Sun Microsystems Inc. or Apollo Computer Inc. Though currently implemented only on Multibus boards, the company says it can be adapted to other architectures and board form factors. With software, the set will be available to original-equipment manufacturers by October for about $20,000 to $30,000.

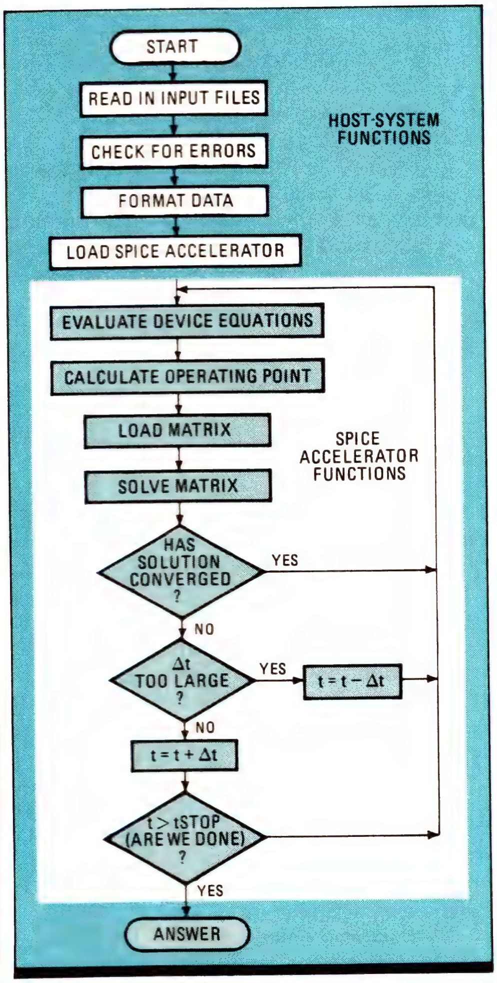
Other companies introduced their own solutions to time-consuming simulation. Work-station designer Daisy Systems Corp. has developed a high-speed network application, Daisy Access, that gives the company's work station users interactive access to the hardware-accelerated logic simulation and physical modeling extension of the company's Megalogician work station.

Using speed. Daisy Access runs on the company's Ethernet, so users of most Daisy stations, from the Personal Logician AT to the Master series, can take advantage of the Megalogician's simulation speed. Beginning in October, the Daisy Access facility will be standard with all new Daisy systems and editions of Daisy-DNIX, the company's implementation of AT&T Bell Laboratories' Unix operating system.

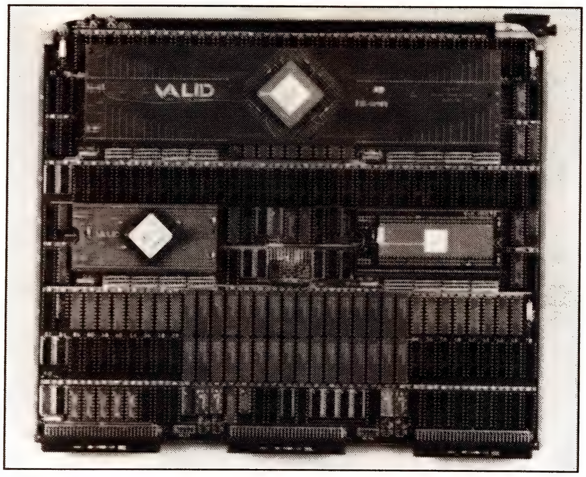
Another network resource is Cadnetix Corp.'s CDX-77000 Simulation Engine, a hardware enhancement to the company's 9000-series product line. The CDX-77000 can simulate up to 1 million equivalent gates and run at a rate of about 200,000 evaluations per second. Dependent on a high-speed bit-slice processor with 88-bit-wide microcoded instructions, the engine supports up to 15 work stations as a shared resource with its up to 3.5 megabytes of memory.

The CDX-77000, which can handle both IC and pc-board design applications, uses Cadnetix' Cadat primitive library, which has been microcoded into 88-bit-wide instructions to provide accelerated access to ALUs, ROMs, logic devices, expandable counters, and a range of transistors for accurate simulation of MOS technologies. Cadnetix says the simulation engine can be used to supplement design environments that require a dedicated source for accelerated simulation. Available this fall, the CDX-77000 will sell for $59,900.

Another trend apparent at the DAC was the combination of products by different companies to provide integrated packages. One such marketing agreement saw Teradyne Inc. and Valid Logic Systems Inc. joining forces to market an integrated simulation and modeling



Flow. Weitek's accelerator relieves the host of most of the simulation process.



Accelerators. Valid Logic Systems' Realmodel (above) and the Mach 1000 from Silicon Solutions (left) boost simulation speed.

system. Using Valid's Realchip hardware modeling system and Teradyne's Lasar Version 6 logic-simulation software, the integrated package can perform logic simulation with true minimum and maximum timing analysis and fault simulation of board designs that include complex VLSI components.

Initially available only on Valid's work stations, the package will later be adapted for use on DEC's VAX series of 32-bit machines. When installed on a Valid work station, the Realchip Modeling System, including interface software for Lasar, sells for $29,500; Lasar Version 6 sells for $18,000.

Valid also introduced Realmodel, a hardware modeling and simulation acceleration processor based on the company's Realchip and Realfast technology. Valid says the new processor's strength comes from its ability to handle mixed-node simulations containing behavioral, gate-level, and hardware models all in the same design. Realmodel runs at 500,000 events/s and features a 32-megabyte/s direct-memory-access link over a 64-bit-wide bus between the hardware modeling and simulation engines.

Teradyne also said it had improved Lasar Version 6 to boost accuracy and efficiency in a new Version 6.2. The improved version performs simulation faster with two new features. The first, called Simulite, is a process that helps to execute simulation functions three to eight times faster than previously possible. By eliminating the timing-hazard analysis function in full Lasar simulation, Simulite boosts speed in applications where timing hazards have already been eliminated or are momentarily not being considered.

In addition, a behavioral-modeling capability will be available in Lasar Version 6.2. That function will enable the simulator to boost throughput considerably, since it can evaluate behavioral models as much as 30 to 50 times faster than structural models.

Zycad, the recognized leader in logic- and fault-simulation accelerators, and Silicon Solutions, a newcomer to the game, also introduced simulation engines at the DAC (*Electronics,* June 24, 1985, p. 27). Zycad, which established itself with high-end logic simulators, introduced the Expeditor and Sprintor simulators.

The Sprintor, a compact, hardware-based logic- and fault-simulation engine, is designed to be integrated into a Multibus-based engineering work station or personal computer cabinet, such as that of IBM Corp.'s Personal Computer AT. The Sprintor can perform at a rate of 200,000 events/s and can simulate designs with up to 25,000 gates, or 16,000 modeling elements. Available only on an OEM basis, a fully implemented Sprintor will cost from $15,000 to $20,000, Zycad estimates.

The Expeditor, Zycad's new turnkey simulation package, can be installed on VAX systems, the Microvax, the IBM PC AT, as well as Apollo work stations. Running at a rate of about 1 million events/s, the package can simulate circuits with twice the number of gates and modeling elements as the Sprintor. Priced from $95,000 to $125,000 (there are two models, one capable of simulating 25,000 gates, the other 50,000), the system uses the company's Zilos software interface and an event-driven timing-wheel algorithm implemented in hardware.

Along with Silvar-Lisco, a CAE software company in Menlo Park, Calif., Zycad also announced an agreement to offer a verification system integrating the two companies' products. The merged products include Silvar-Lisco's Helix, a multilevel behavioral simulator, and Zycad's four families of simulation processors, including Sprintor and Expeditor. The companies are promising availability in early 1986, and say the package will be compatible with a variety of computing environments.

Silicon Solutions Corp. introduced the Mach 1000 simulation engine, a hardware accelerator that claims to execute gate-level simulations 1,000 times faster than software on a VAX-11/780. The low-cost system (it is priced at $85,000 when configured for logic simulation of up to 65,000 gates, or $150,000 when configured for logic and fault simulation with the same capacity) relies on custom VLSI chips instead of complex pc boards to keep costs down and throughput up. The company claims that a 10,000-gate simulation that takes up to a full working day on a VAX system can be performed by the Mach 1000 in less than a minute. This can lead to cutting several weeks off the standard design process.

–Tobias Naegele

SIMULATION-ACCELERATOR MAKERS

Cadnetix Corp., 5757 Central Ave., Boulder, Colo. 80301. Phone (303) 444-8075 [Circle reader service number 403]
Daisy Systems Corp., 700 Middlefield Rd., Mountain View, Calif. 94043. Phone (415) 960-0123 [Circle 401]
Silicon Solutions Corp., 1380 Willow Rd., Menlo Park, Calif. 94025. (415) 321-8574 [Circle 402]
Silvar-Lisco, 1080 Marsh Rd., Menlo Park, Calif. 94025. Phone (415) 324-0700 [Circle 406]
Teradyne Inc., 321 Harrison Ave., Boston, Mass. 02118. Phone (617) 482-2700 [Circle 404]
Valid Logic Systems Inc., 2820 Orchard Pkwy., San Jose, Calif. 95134. Phone (408) 945-9400 [Circle 405]
Weitek Corp., 1060 E. Arques, Sunnyvale, Calif. 94086. Phone (408) 738-8400 [Circle 400]
Zycad Corp., 3499 Lexington Ave. N., St. Paul, Minn. 55112. Phone (612) 631-3175 [Circle 407]

RUBY LASER DRILLS HOLES WITH PRECISION

Modified IBM PC/XT tames powerful laser for fine, accurate pc-board work

Rubies are the bucking broncos of the laser herd. They pack a powerful kick in the form of very high peak power, but they are extremely hard to control.

Now a Massachusetts company says it has harnessed the ruby laser through computer control. It can use the laser to drill very small holes of nearly unmatched accuracy in materials commonly used in electronics.

It has been commonly believed that pc boards cannot be drilled with lasers, much less with ruby lasers. Despite their very high peak power and the fact that their light is readily absorbed by materials such as gold, copper, and silicon, their extreme sensitivity, particularly to temperature, has prevented more extensive use in the industry.

But Advanced Laser Systems Inc., in Waltham, says that these problems have been resolved in its new model 604 ruby laser—to the point where the laser can drill pc-board holes in the 4- to 12-mil range and to tolerances as fine as ±0.0001 in. George Zahaykevich, president of Advanced Laser Systems, says that this accuracy has been achieved by extending the control of the system across many levels, with a modified IBM Corp. Personal Computer XT providing the coordination.

The 604 laser uses a switching power supply with variable frequencies that optimize the supply across the entire charging cycle. This method holds voltage regulation to within ±0.05%, says Zahaykevich.

To further ensure precise firing voltage, the laser uses comparators and an accurate voltage-reference set. A solid-state driver controls power from the storage capacitors and also maintains a simmer current through the lamp when it is not firing. The simmer current holds a uniform flash path through the lamp and also extends the lamp's life.

The unit is first programmed for the desired voltage and number of pulses. The computer then closes the silicon-controlled-rectifier gates on the simmers and thereby isolates the lamp, and the power supply begins to charge the capacitors. When the desired charge level is reached, the computer opens the SCR gates and the charge runs through the lamp. During the firing phase, the computer disables the power supply so the lamp is not fed a constant voltage. After the charge has been fully dumped, the computer shuts the SCRs and once again enables the power supply.

Zahaykevich says the computer interface, implemented on two boards of proprietary design in early test models, will be reduced to one board in future units. The interface has diagnostic capability and responds with error messages to power-supply or cooling-system failures, and timing loop problems. The interface also has a simulation mode and allows manual operation.

The laser output power is up to 15 joules per pulse. At full power, 6.6 pulses/s are possible, and 10 pulses/s at normal working ranges. The unit's peak pulse power is 50,000 W. The required input voltage is 220 V, three phase. On the average, 10 kW are delivered to the laser head.

Lensing action. Each laser hardware setup can provide a beam-diameter ratio of approximately 10 : 1. The ruby rod's lensing action—that is, the lengthening and tapering of the rod caused by the heat generated in firing—adjusts the diameter of the beam on the 604.

"By controlling the power and cooling very precisely, [the user] can control lensing," says Zahaykevich. This in turn allows precise control of the beam's diameter.

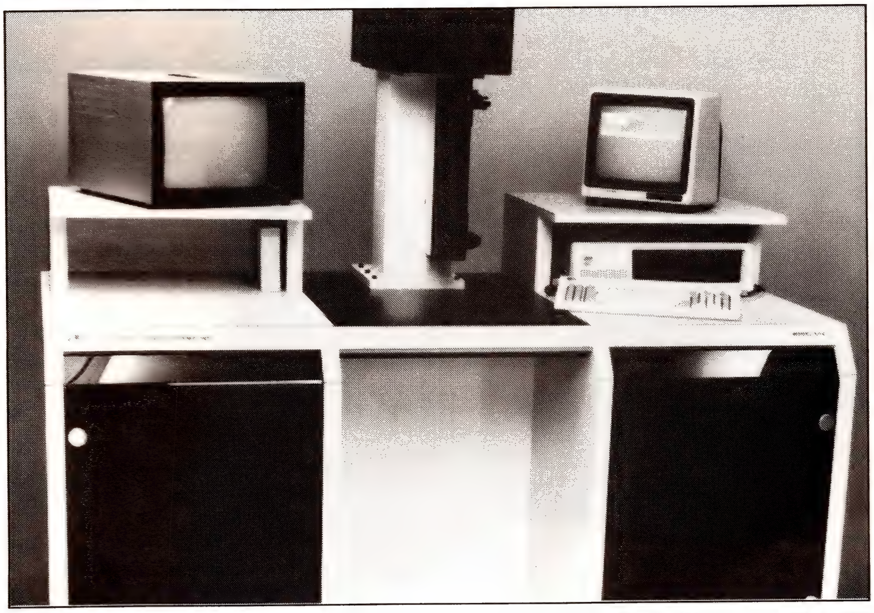
Cooling the laser was the biggest obstacle to developing the system. The temperature had to be held to within 0.5°F and the rod had to be cooled quickly and uniformly to avoid electrical interference. The modified unit uses deionized water and specially designed gold-plated-copper rod holders to avoid heat buildup at contact points.

Even lamp drift can be significant for a ruby laser. "Over 5 million or so shots, the lamp will drift down 20%," says Zahaykevich. Using an electro-optical pickup, the computer monitors the flash output and adjusts the flash by resetting the comparators to compensate for the drift.

A beta-site unit went out to a major computer company last December. A source at that company says the laser is relatively trouble-free and lives up to the company's claims of drilling ability. The quality of the holes has also been good, the source says.

Zahaykevich says that the ruby is a particularly good cutting tool. The reason is that rather than melting through material and leaving a recast layer along the perimeter of a hole, as a lower-intensity laser might do, the ruby's intense power peaks vaporize the material, leaving very clean holes. In drilling through multiple layers, he says the laser does not smear epoxy and provides excellent etch back, which improves the quality of soldering.

The system has been used in house to repair hairline shorts on pc boards and



hybrid circuits, drill precision holes in silicon, trim thermistors, and drill fiber-optic connectors, as well as for nonelectronics machining.

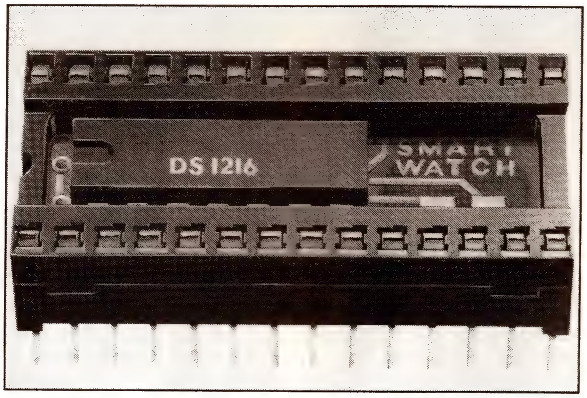
As part of the package, the model 604 includes a video monitor so operators can observe the drilling process, the laser, head, and IBM PC/XT with an interface. The price is $86,200, and delivery takes 90 days. *–Craig D. Rose*

Advanced Laser Systems Inc., 223 Crescent St., Waltham, Mass. 02154. Phone (617) 891-8418 [Circle reader service number 338]

SOCKET WITH BATTERY RETAINS SRAM's DATA

Without any system power, the DS1216 Smartwatch from Dallas Semiconductor Corp. keeps track of time down to the hundredth of a second as well as keeping the data stored in a CMOS static RAM current for a minimum of 10 years. The Smartsocket is the latest in a series of products relying on embedded lithium batteries to power chip-tailoring memory cells [*Electronics-Week,* Jan. 7, 1985, p. 17].

What makes the Smartwatch tick is an embedded lithium energy cell plus on-board power-sensing circuitry that switches both the bytewide RAM and the timer chip to the battery backup whenever the system is shut off. The DS1216 has a 28-pin DIP socket, which accepts conventional 2-K-by-8-bit and 8-K-by-8-bit memories.



The Smartwatch is designed to retrofit into existing bytewide memory slots (ROM and RAM) of board designs without any extra components, says Michael Bolan, director of marketing at Dallas Semiconductor. For example, the new component allows automatic data and time documentation of system activities.

"You can take a system that was never originally engineered to keep track of time, and by changing the assembly—putting [Smartwatch] in as opposed to a regular ROM for the operating systems—you can have a system that keeps track of time." Other timekeeping ICs often require extra off-chip logic and a number of components—including a separate battery energy source, he adds. The embedded lithium battery is sealed inside the socket portion of the Smartwatch to protect against contamination.

The timekeeping system tracks hundredths of seconds, seconds, minutes, hours, days, months, years, and dates. It automatically compensates for leap years and short months. The Smartwatch is actually an extension of nonvolatile-storage features offered in the earlier DS1213 Smartsocket.

The Smartwatch adds a low-power timer circuit that is mounted in the trough between the two rows of DIP pin sockets. Using copper traces on the Smartsocket, the timekeeping circuit is interconnected to some of the memory pin connections.

Software controls the operation of watch functions and operation is transparent to the access of the memory chip plugged into the socket, says Bolan. Special circuitry on the timer enables the chip to temporarily disconnect the SRAM. It then connects itself to the system memory bus, sending time information to the host processor before reconnecting the memory.

A 64-bit codeword controls the timekeeping function by "waking up" the watch circuit. A read cycle to the memory location of the Smartwatch initiates the pattern-recognition sequence, which extracts and updates data in the unit. Eight registers of 8 bits each hold time information. Each is accessed sequentially: data is transferred out in a serial bit stream.

Bolan says the embedded power source is enough to power the watch plus retain data in a conventional low-power SRAM for a minimum of 10 years.

Available for immediate delivery, the DS1216 Smartwatch is priced at $19.25 each in 100-piece quantities.

Dallas Semiconductor Corp., 4350 Beltwood Pkwy., Dallas, Texas 75234.
Phone (214) 450-0400 [Circle 339]

DIP RESISTOR NET HANDLES 2.2 MEGOHMS

Available in values from 22 Ω to 2.2 MΩ for higher pc-board density requirements, 14- and 16-pin DIP resistor networks feature compact design for pull-up, pull-down, and voltage dividing.

Designed for applications in telecommunications equipment, disk drives, digital circuits, and computer hardware, the DIP resistor networks are compatible with automatic-insertion equipment. Delivery is from stock up to eight weeks. Custom DIP and single in-line package resistor-network designs are available. In orders of 10,000, pricing is $0.012 per pin, or about $0.17 for the 14-pin version and about $0.19 for the 16-pin model.

Kyocera International Inc., Electronic Components Group, 11425 Sorrento Valley Rd., San Diego, Calif. 92138.
Phone (619) 454-1800 [Circle 366]

RELAY SWITCHES 20 MILLION TIMES

Designed for high-power applications, a series of compact pc-board relays can be mounted in any position and comes in both open and closed models.

The ZC series of relays can handle nominal dc voltages of 3-, 6-, 10-, 12-, 24-, and 48 V. They boast a current rating of 40 A, and their contacts are rated at 360 W/720 VA. Coil power is only 1.3 W.

The relays have a mechanical life of more than 20 million cycles, the manufacturer says. They sell for under $1 each in 1,000-unit quantities and take six to eight weeks for delivery. The manufacturer has a variety of contact options for the parts.

Schrack North America Inc., 3 Westchester Plaza, Elmsford, N.Y. 10523.
Phone (914) 592-1305 [Circle 365]

RECTIFIER MODULE HAS 160-A RATING

A low-profile Schottky-diode module can replace two individually packaged diodes in those applications that require 5-V rectification.

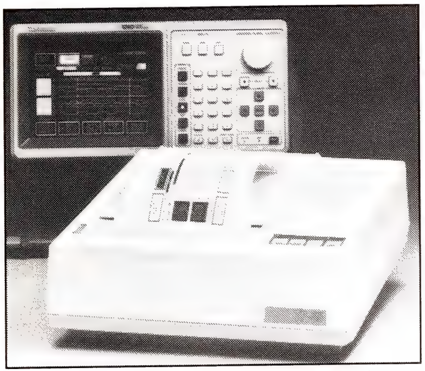
The 161CMQ center-tap module is rated at 160 A, ranging from 30 V to 50 V. The component can handle temperatures up to +175° C and can be used in parallel for increased output current. Features include guard-ring reverse protection, guaranteed reverse-avalanche capability, and complete electrical isolation, so designers can mount it directly to the bus bar, frame, or any type of heatsink without mounting hardware.

Samples of the 161CMQ are available immediately from stock, and production quantities take from 8 to 12 weeks for

delivery. Prices are available on request.
International Rectifier, 233 Kansas St., El Segundo, Calif. 90245.
Phone (213) 772-2000 [Circle 367]

PRINTER CAPTURES CRT'S OUTPUT

Bypassing a camera, the TP-35 video printer creates hard copy of a logic analyzer or similar instrument directly from its CRT display. The process is multihead thermal printing in black on white or white on black, with a density of 3 or 6 dots per millimeter (selectable by switch). Generating hard copy takes 16.7 s per screen in the low-resolution mode, 27.9 s in the high-resolution mode.

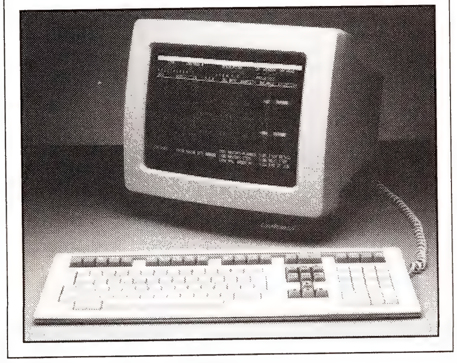


The TP-35 has input terminals for a composite video signal, separate video signals, and composite synchronization signals. It is synchronized with the user's system with a custom, plug-in clock board. These are available for some logic-analyzer models from the manufacturer of the TP-35 or for similar models from other manufacturers. Including the clock and paper, the TP-35 is $1,295, with delivery from stock.

Test & Measurement Systems Inc., 349 Cobalt Way, Suite 301, Sunnyvale, Calif. 94086. Phone (408) 720-8877 [Circle 345]

DEC TERMINAL MIMIC HAS COLOR DISPLAY

Owners of Digital Equipment Corp. computers can have the advantages of color with the Colortrend 220, a VT220-compatible terminal. The model 220 offers Colorkey, so users can add color to



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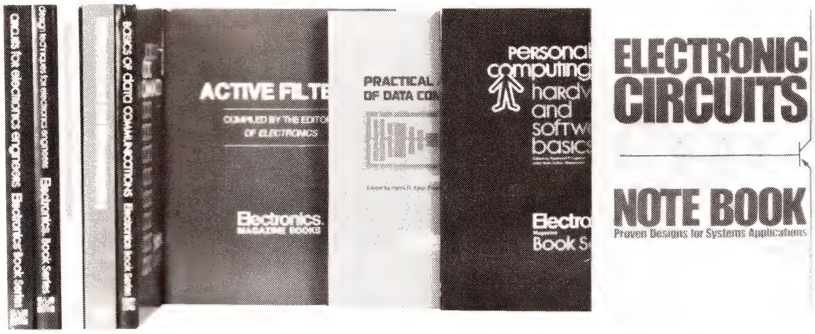

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Basics of Data Communications
This compilation of essential articles from *Data Communications* magazine includes chapters on terminals, acoustic couplers and modems, communications processors, networking, channel performance, data link controls, network diagnostics, interfaces, and regulations and policy. Pub. 1976, 303 pages, softcover.
Order No. R-608, $15.95.

Practical Applications of Data Communications
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Order No. R-903, $15.95.

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monochrome software without reprogramming. With Colorkey, the user considering the purchase of the VT220 can add color without having to scrap existing software developed for the VT100 and VT220. Colorkey is also compatible with the VT52.

The Colortrend terminal offers eight selectable foreground colors on any of eight background colors. It can simultaneously display four character sets—ASCII, foreign-language, thin-line graphics, and a fourth that can be downloaded from a host. Characters are formed in a 7-by-10-dot display with a pitch of 0.31 mm between dots within a 10-by-10-dot matrix.

Colortrend 220 comes with a 14-in. CRT that tilts to various positions. The CRT has 132 viewable columns, a keyboard with 13 programmable keys, and an auxiliary 18-key numeric keypad. Priced at $1,295 in 100-piece quantities, evaluation units are available now, with volume shipping scheduled to begin in late summer.

Intecolor Corp., Intecolor Dr., 225 Technology Park, Norcross, Ga. 30092.
Phone (404) 449-5961 [Circle 346]

PRINTER JUGGLES VARIOUS PAPERS

Flexible paper handling is an upfront benefit of the C7500, the first of the C-Line product family of multicolor printers. The standard fanfold or cut-sheet tractor feed adapts to feed from the rear or the bottom of the printer. With demand document printing, a user can tear off forms or fanfold paper within ½-in. of the last printed line, for a car-rental contract, for example. In the office, the machine can print single-sheet cut paper while holding the continuous fanfold paper in standby.

The C7500 stores two sets of print parameters; using the printer's keypad, users can switch between the two.

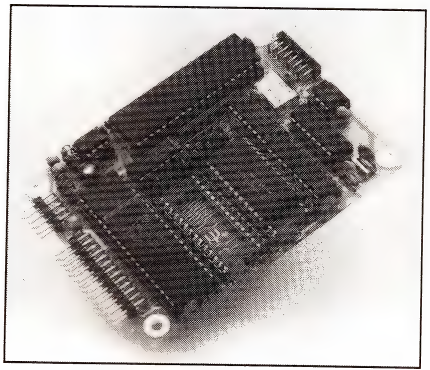
The company calls the C7500 a mid-range—400 to 600 pages per day—upgrade, with a suggested list price of $2,495. With its parallel and serial ports and simple print-parameter setup, it connects with most popular computers. For original-equipment manufacturers who want to customize the C7500, the standard I/O board can be switched easily with a different I/O board for a proprietary system.

Printing up to 15 colors, the C7500 prints graphics at a rate of 400 dots/s, near letter-quality text at 100 characters/s, and draft-quality text at 400 characters/s.

Facit Inc., 9 Executive Park Dr., Merrimack, N.H. 03054.
Phone (603) 424-8000 [Circle 344]

CONTROLLER CARD HANDLES 40 I/O LINES

For under $200, depending on quantity, original-equipment manufacturers can purchase a 3-by-4-in. microcontroller card with 2-K bytes of RAM and 40 programmable I/O lines.



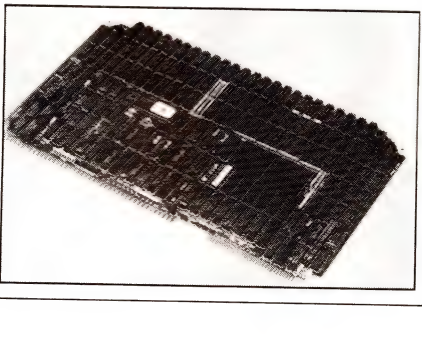
The MC-1Z, designed for applications in instrumentation, processor control, and research and development, is based on the Zilog 8671 processor. By adding more chips, users can upgrade it to include 16-K bytes of RAM or 8-K bytes of EPROM. Included onboard is a clock/calendar, two timer/counters, six interrupts, and an EPROM receptacle. The board is available now.

Basicon Inc., 11895 N.W. Cornell Rd., Portland, Ore. 97229.
Phone (503) 626-1012 [Circle 357]

MEMORY CARDS ARE DUAL PORTED

A series of memory boards includes the dual-ported PSM 512DA iLBX bus memory board, which has 512-K bytes of dynamic RAM arranged in segments of 128-K bytes. The PSM 2DA, the second board in the series, can boost total capacity to 2 megabytes.

Both boards have 24-bit addressing on either the Multibus or iLBX local buses, and noncorrecting local buses feature access times as short as 200 ns. Both boards also feature error detection and correction. This allows them to rapidly detect double-bit errors and to both find and fix single-bit errors.



The boards are compatible with all 8- and 16-bit microprocessors. Single-unit prices begin at $1,117 for the 512-K-byte board and range up to $2,635 for 2-megabyte boards. Custom configurations and discounts for original-equipment manufacturers are available.

Plessey Microsystems Inc., 1 Blue Hill Plaza, Pearl River, N.Y. 10965.
Phone (914) 735-4661 [Circle 358]

CONTROLLER RUNS FOUR DRIVES

The M1053A Small Computer System Interface Disk Controller can support up to four 337-megabyte Winchester disk drives.

The board supports its manufacturer's family of 8-in. drives, and the company says it features the full standard and extended SCSI command set as well as a high-speed storage module drive interface that provides a 2.46-megabyte/s synchronous data-transfer rate. Incorporating five custom large-scale ICs, the board is scheduled for July delivery in production quantities. The price is $895 each quantities of 100.

Fujitsu America Inc., 3055 Orchard Dr., San Jose, Calif. 95134.
Phone (408) 946-8777 [Circle 359]

DENSE RAM MODULES MEASURE 2 BY 3½ IN.

Surface-mounted dynamic RAMs and a controller assembled into plug-in modules make up the Mikul 62000 series of pseudo-static RAM modules. The mass-memory modules can be mounted on any pc board with the installation of two rows of single-in-line-package sockets.

The 2-by-3½-in. modules, easily connected with most 8- and 16-bit microprocessors, have access times of 140, 170, and 220 ns. Sample quantities will be available in September. Production quantities will be ready in December, as will samples of a 120-ns version.

The high-density units come in four configurations. For parts with 220-ns access time, pricing is as follows: the 62064, which has 128-K bytes of memory, sells for $349; the 62128, with 256-K bytes, for $495; the 62356, with 512-K bytes, for $595; and the 62512, which boasts 1 megabyte, for $995.

T. L. Industries Inc., 2541 Tracy Rd., Toledo, Ohio 43619.
Phone (419) 666-8144 [Circle 355]

12,000-MIL^2 DIE HOLDS 64-K EPROM

The M2764A's die size of just 12,000 mils^2 makes it a very small 64-K bit EPROM.

The chip is built in an SGS Semiconductor Corp.'s proprietary NMOS-E3 technology, and its small size improves

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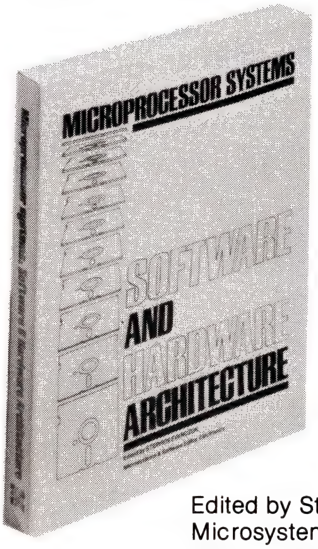

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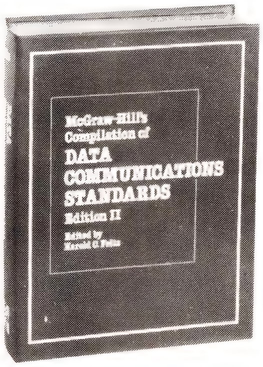

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performance and reliability, the manufacturer says. Features include a fast programming algorithm, an electronic signature, a two-line control function, TTL-compatibility, and a standby mode than more than halves the maximum active current.

The chip comes in two versions—one that can withstand temperatures between 0° C and +70° C and one that can survive temperatures between -40° C and +85° C. Access times of 200, 250, 300, or 450 ns are available for the memory, which comes in a 28-pin ceramic DIP. Pricing, in lots of 1,000, is $3. Delivery is from stock.

SGS Semiconductor Corp., 1000 E. Bell Rd., Phoenix, Ariz. 85022.
Phone (602) 867-6100 [Circle 356]

FEWER WRITE CYCLES CUT EEPROM'S COST

The XL2816A/E2 16-K EEPROM provides 100 write cycles rather than the typical 10,000 reprogramming cycles, thereby keeping the price of the memory under $5 for some models.

The memory chip, which comes in versions with four different access times, is fully compatible with the industry-standard 2816A, available from various vendors. Organized as 2,048-by-8-bits, the units have 5-V read and write cycles, internal address and data latches, timing circuitry, and protection against inadvertent writes during power-supply changes.

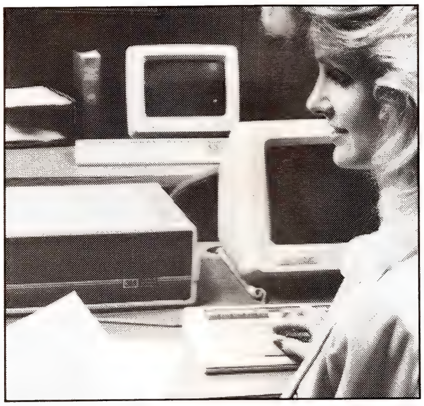
The XL2816A/E2 fits existing EEPROM and static-RAM sockets and comes in a standard Joint Electron Device Engineering Council 24-pin package. Its 10-ms write operation needs no hardware support, freeing system buses for tasks while the memory handles the write cycle.

In 100-unit orders, commercial-temperature plastic-packaged versions of the part are $4.95 each for 450-ns access time, $5.30 for 350-ns access time, $5.90 for 300-ns access time, and $6.65 for 250-ns access time. Hermetically sealed versions are also available.

Exel Microelectronics Inc., 2150 Commerce Dr., San Jose, Calif. 95131.
Phone (408) 942-0500 [Circle 354]

NETWORK MEETS IEEE MAP STANDARDS

A local-area network that conforms to the Manufacturing Automation Protocol, LAN/II operates over a single coaxial cable and supports multiple-rate synchronous and asynchronous data links. It meets both the IEEE-802.3 baseband and 802.4 broadband specifications: the baseband system uses an Ethernet-type cable for office applications; the broadband system uses a token-passing protocol for communications-access control. Both offer a 10-Mb/s data rate.



LAN/II links industrial equipment, work stations, laboratory facilities, and remote networks through MAP standardization of industrial LAN systems, the company says.

Price and delivery depend on configuration; the company will quote these on request.

Interactive Systems/3M, 3M Response Center, 101 Decatur Ave. N., Suite 205, Minneapolis, Minn. 55427 [Circle 352]

NET USERS CAN SHARE UNIX RESOURCES

The Universe line of high-end microcomputers can be clustered to share Unix System V capabilities in an ISO-MAP network through Unicluster. With this hardware and software package, systems in the network can share a common file system, resources, and applications. Unicluster is made up of IEEE-802.3 connection hardware and International Organization for Standardization, Manufacturing Automation Protocol, and Technical Office Protocol software that is added to a Universenet local-area network.

Using its Distributed Resource Management System, Unicluster will support distributed file systems, execute jobs at a remote location, and interact with any system in the network over virtual terminal connections—which also reduce the network's cabling. Further, electronic mail, messaging, and printer spooling are all performed under Network Application Services. Passwords protect all functions on the network from unauthorized users.

Available immediately, Unicluster sells for $2,000 per node for new users; the software is available free to current Universenet users as part of the company's updating service.

Charles River Data Systems Inc., 983 Concord St., Framingham, Mass. 01701.
Phone (617) 626-1000 [Circle 351]

ENGINE DRAWS 64,000 VECTORS/S

Designed for applications including mapping, computer-aided design and engineering, and command and control, the CM 1024 Colorgraphic Computer has a high-resolution, 19-in., noninterlaced monitor and a display engine that processes 64,000 vectors/s.

The 60-Hz monitor, which has a 1,024-by-768-pixel resolution, complements the display-engine digital drawer and its 16-bit 68000 processor. The drawer also includes 4-K bytes of CMOS RAM, a hardware vector generator, a 24-slot card cage, extended plotting, complex fill, and raster processor graphics.

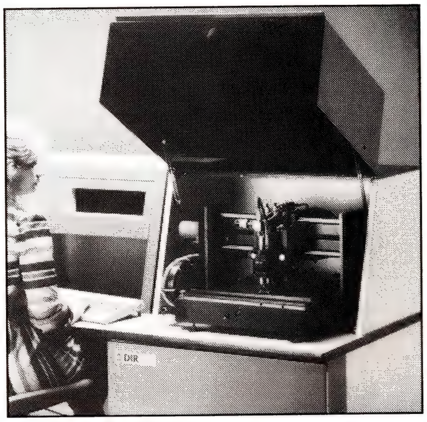
Choice of software includes the Idris graphics operating system, Fortran 77, C, Pascal, and DI 3000 Extended graphics system. Local storage is available in dual floppy-disk drives and up to 80 megabytes of fixed-disk storage. The system can support up to eight planes of double-buffered refresh memory, for a palette of 16 million colors.

A base CM 1024 system, including four single-buffered image planes, 512-K bytes of RAM, graphics firmware, a 1,024-by-768-pixel display monitor, and the Colorgraphic engine, sells for $23,995 and is available now.

Chromatics Inc., 2558 Mountain Industrial Blvd., Tucker, Ga. 30084.
Phone (404) 493-7000 [Circle 364]

SYSTEM AIMS FOR PC-BOARD DESIGN

Engineers can generate a prototype pc board, validate it, and produce a corrected board in-house in one day with the Board Maker, says the maker of this computer-aided-design tool. A work station for layout, test, and production of pc boards in an engineering laboratory, the turnkey Board Maker includes software, a four-function table (that can perform mill, drill, rout, and plot functions) with a high-speed spindle and plotting head, a console with a dust/sound



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cover, and an IBM Corp. Personal Computer or PC/XT.

Any IBM PC with 256-K of RAM and dual 320-K-byte floppy-disk drives can drive the system. Users can enter circuit drawings on the system with standard Gerber files or CAD software that runs on the IBM PC. The Board Maker sells for $44,990 per unit; quantity discounts are available. Delivery takes 30 days after receipt of order.

Advanced Technologies Inc., 624 E. Evelyn Ave., Sunnyvale, Calif. 94086.
Phone (408) 733-7459 [Circle 363]

LEXIDATA'S WINDOWS WORK IN REAL TIME

With Lexidata's Virtual Windows software, color-graphics windows management enters the fourth generation, the company claims.

Unlike earlier windowing techniques, Virtual Windows does not require information stored on computer-screen windows to be moved back and forth between display memory and the host computer or disk memory.

This technique makes possible the first true real-time color window. Two other features that are not found in current windowing technology are the display of solid overlays and support for true color images in up to eight active windows. The three earlier techniques Lexidata hopes to supplant with its new technology are software windows, split-screen windows, and windows based in firmware.

As an example of Virtual Windows' power, users can read and store up to 24 planes of true color in a window area, then display the data in real time—in less than 0.03 s—without any bottleneck in the work-station CPU or on the bus. The package is for all popular minicomputers, including those from Digital Equipment, Data General, Honeywell, Perkin-Elmer, MassComp, and Hewlett-Packard.

A medium-resolution system, the Lex 90/35, sells for under $17,000. A high-resolution unit sells for $23,000. Delivery takes 90 days.

Lexidata Corp., 755 Middlesex Tpk., Billerica, Mass. 01865.
Phone (617) 663-8550 [Circle 384]

UNIX WORK STATION DOESN'T USE SERVER

Better known for its Omninet local-area network, Corvus Systems Inc. has entered a new market with Cheetah, its graphics engineering work station running under Unix. Cheetah uses the 10-MHz Motorola 68010 microprocessor and has a direct-memory-access disk controller (with 68000 processor). Its minimum configuration is 1 megabyte of main memory (expandable to 4 megabytes), 4 megabytes of virtual memory per process, a 20-megabyte Winchester disk drive, a 1.2-megabyte 5¼-in. floppy-disk drive, and a 15-in. 800-by-620-pixel monochrome monitor.

The work station needs no server—each system links with the network and handles activity on it without disturbing other operations. Though another work station, the Corvus Concept, has been marketed to original-equipment manufacturers for two years, Cheetah will compete against other high-end Unix work stations such as the Sun Microsystems Inc. 2/120.

Cheetah will first be available with Unix 3.2, with Unix System V to be transported to it soon. Prices start at $9,995.

Corvus Systems Inc., 2100 Corvus Dr., San Jose, Calif. 95124.
Phone (408) 559-7000 [Circle 383]

GRAPHICS SYSTEM USES MICROVAX II

Based on the floating-point processor for the Microvax II, Digital Equipment Corp. is introducing what it says is its most powerful color work station. The Vaxstation 520 is a high-resolution work station that includes 2 megabytes of memory, an Ethernet interface, the MicroVMS operating system, 32-megabyte Winchester disk drive, and dual 400-K-byte floppy-disk drives.

Besides the 32-bit Microvax II processor, the Vaxstation 520 features a Tektronix 4125 graphics subsystem. Resolution is 1,280 by 1,024 pixels. The system, priced at $42,790, will be available in the summer.

Digital Equipment Corp., Maynard, Mass. 01754. Phone (617) 467-4035 [Circle 382]

SUBROUTINES MAKE MATH JOBS EASIER

Many math-intensive applications programs contain repetitive, numerically intensive kernels that are industry specific. To meet the needs of engineers and scientists who must work with such programs, Math Advantage saves software development time with its library of preprogrammed algorithms—nearly 180 subroutines that find application in such disciplines as seismic research, real-time signal processing, and structural analysis. The Math Advantage library can be called from programs written in either Fortran or C language.

Currently, the Math Advantage runs on more than 20 different computers, from 16-bit personal computers through

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32-bit work stations and low-end supercomputers and scientific processors. To accommodate specific architectures, the company will custom-tune Math Advantage subroutines for maximum speed, using techniques such as loop unrolling for vector machines or loop ordering for two-dimensional arrays.

Prices for the Math Advantage vary with the type of system ordered, ranging from $495 on IBM Corp. Personal Computers to $2,000 on 32-bit work stations and up to $10,000 on supercomputers. It is available now.

Quantitative Technology Corp., 8700 S.W. Creekside Pl., Suite D, Beaverton, Ore. 97005. Phone (503) 626-3081 [Circle 340]

SOFTWARE DESIGNS ICs ON IBM PCs

Software to perform all tasks required for the design of custom ICs using standard cells makes up the Sceptre II package, which runs on personal computers including the IBM Corp. Personal Computer, PC/XT, and PC AT; the NEC Corp. 9801; and the Victor 9000. Sceptre II comes with the manufacturer's library of 3-μm single- and double-metal CMOS cells.

Once the design is completed and verified, the manufacturer gets the design data on a floppy disk. The manufacturer then creates a pattern-generator tape for mask making and wafer fabrication. Because Sceptre II is compatible with all the manufacturer's computer-aided-design and -engineering tools, users can choose to transfer a circuit design to the company for completion at any point in the process, rather than finishing it themselves.

Sceptre II is available now as part of the manufacturer's standard cell-design kit for a one-year licensing fee of $750.

Gould AMI Semiconductors, 3800 Homestead Rd., Santa Clara, Calif. 95051.
Phone (408) 554-2041 [Circle 341]

STATISTICS PACKAGE RUNS UNDER PC-DOS

Interactive statistical procedures for both simple and sophisticated analysis are available through SAS/Stat, a package that runs under the PC-DOS operating system. The software package includes subroutines that perform regression, variance, discriminant, and common-factor and component analyses, as well as scoring.

SAS/Stat is delivered on master disks formatted for IBM Corp.'s Personal Computer XT. To use the statistical software, sites must first have base SAS software, an all-purpose data-management and analysis tool running under PC-DOS. SAS/Stat is licensed on an annual basis, with fees based on the number of work stations supported; for 50 work stations, for example, the fee would be $2,000 for the first year. SAS/Stat will be available in the fourth quarter of this year.

SAS Institute Inc., Box 8000, SAS Circle, Cary, N.C. 27511.
Phone (919) 467-8000 [Circle 342]

PROGRAM SIMULATES A CALCULATOR

Said to be more sophisticated than hand-held calculators, Slipstick is a calculator-simulation software package for the IBM Corp. Personal Computer and compatibles that performs such tasks as elliptic integrals and Jacobian elliptic functions, as well as statistical tests that include normal and chi-square distributions. It performs matrix operations on matrices in sizes up to 20 by 20, and performs matrix multiplication, inverses, eigenvalues, and eigenvectors with a single keystroke.

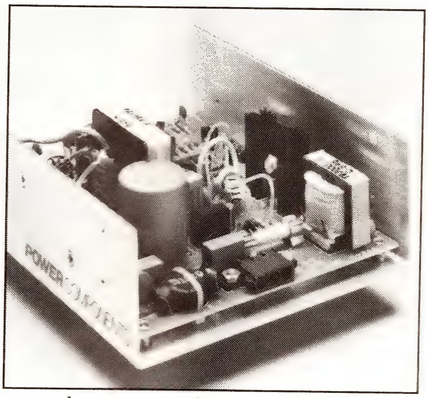
Slipstick will accept programs up to 145 instructions long and can calculate the root of a function when both the function and its derivative have been programmed. When operating on polynomials, Slipstick can find the roots of a fifth-degree polynomial in about 5 seconds.

The manual and a demonstration disk for Slipstick cost $25, $20 of which will be applied to the purchase price of $200.

Jim Serwer, P.O. Box 116, Campbell, Calif. 95009. Phone (408) 296-4763 [Circle 343]

100-W SWITCHERS CAN BE CUSTOMIZED

A series of 100-W switching power supplies can be purchased as standard units, which are available immediately, or as customized units, for which delivery takes two to four weeks. The 1000 series features half-bridge circuitry, trouble-free operation under unloaded conditions, and optional parallel configurations.



Standard versions offer 5- V main outputs and auxiliary outputs of combinations of 5, 12, 15, and 24 V at 1.5 to 5 A. Customized versions can be supplied with a main output of 5 V (to a maximum of 12 A), with up to three auxiliary outputs, which can be any combination of 5, 12, 15, or 24 V. Each output can be ordered to deliver 1.5, 3, or 5 A of output current, provided the overall 100-W rating is not exceeded.

Line regulation on all outputs is 0.1%. Load regulation for the main output is 0.1% or better for a 20%-to-100% or 100%-to-20% load change. Load regulation on auxiliaries is 1% for 0%-to-100% or 100%-to-0% load changes, providing the main output carries a minimum load of 2 A and total output power does not exceed 100 W.

For off-the-shelf standard supplies, the units are priced at $104 for dual outputs and $112 for triple outputs. Customized versions are assessed a one-time $250 engineering charge.

Power Components, 1480 W. 178th St., Gardena, Calif. 90248.
Phone (213) 323-8120 [Circle 372]

CCD IMAGE SENSORS WORK WITH NTSC, PAL

Two solid-state frame-transfer image sensors made with charge-coupled-device technology are suitable for use with TV cameras in both 625-line PAL and 525-line NTSC systems. Besides offering the typical advantages over conventional TV camera imaging tubes—long life and no burn-in, lag, optical distortion, or microphonic noise—the NXA1010 and the NXA1020 sensors have superior resolution and noise rejection compared with competing solid-state devices, the company says.

High resolution is achieved through the 604 equally spaced pixels per line as compared with 380 to 400 pixels per line on competing chips. Horizontal resolution is greater than 400 lines in monochrome and three-chip color cameras and greater than 300 lines in single-chip color cameras.

Greater blue sensitivity is achieved by covering only 70% of the photosensitive area with polysilicon gate electrodes, thereby allowing additional penetration of blue light. The NXA1010 is a monochrome processor; the NXA1020, with an added cyan, green, and yellow striped filter, is a color processor. A photolithographic process is used to place the filter on the CCD chip.

Price and delivery information for the CCDs was unavailable at press time.

Amperex Electronic Corp., Imaging Devices, Slatersville, R.I. 02876.
Phone (401) 762-3800 [Circle 377]

NEW LITERATURE

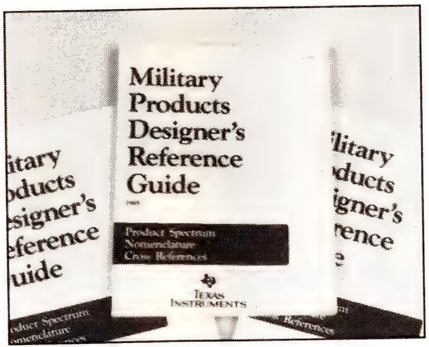
Startup in C. *The C Journal* is a new quarterly for C-language users who program under MS-DOS, PC-DOS, CP/M, Unix, and the operating system for Apple's Macintosh. Upcoming articles and columns include a look at programming-development aids, an overview of C interpreters on the market, reviews of C Ware's Desmet V2.4 development system and the Btrieve access library, transporting programs between Unix and PC- and MS-DOS, interviews with C designers, and more. The editor is Rex Jaeschke, author and member of the American National Standards Institute X3J11 C Language Standards Committee. The charter subscription rate is $18 annually until July 31. The rate is $28 thereafter. Address orders to Infopro Systems, 3108 Rte. 10, Denville, N.J. 07834, or call the firm at (201) 989-0570 [Circle reader service number 421]

Modem data. Telecommunications is the area of interest at Rockwell International's Semiconductor Products Division, as spelled out in their 1985 Data Book. The company is expanding its line of device-set and board-level (original-equipment-manufacturer) modems with units that range in speed from 1,200 to 9,600 b/s for a variety of applications: full-duplex dial-up, leased line, facsimile, and data. Communications and control are also getting their share of attention, including controllers for local-area networks (IEEE-802.3 standard) and Forth development, and kernel ROMs. Standard products are based on the 6500 and 68000 chips. For a copy of the Data Book, which sells for $10, call SPD/Rockwell at (714) 833-4538 or write to Dan Rime, communications manager, through MCI mail. The address of the company's home office is 4311 Jamboree Rd., Newport Beach, Calif. 92658. [Circle 422]

Software reports. Software Digest Inc. publishes reviews on two levels. The *Ratings Newsletter* gives a quick rundown—through charts that tick off such categories as ease of learning, ease of use, error handling, and overall evaluation—of packages for data management, spreadsheets, graphics, and other popular and important categories. The developer who needs the detailed comparative evaluation behind these ratings can go to *Primary Data Reports*, a limited-edition service that reports the scores given to the programs offered by National Software Testing Laboratories. Subscription information for each publication comes in separate brochures, available from Software Digest Inc., 1 Winding Dr., Philadelphia, Pa. 19131 or call (215) 878-9300. [Circle 423]

Unix catalog. The *Unix Solution Catalog* lists software that runs under Venix/86—a version of Unix for IBM Corp. Personal Computers and their compatibles, AT&T, and Digital Equipment Corp. personal computers. This includes the Office Menu Tool; the Connector, which runs DOS as a Unix process; Viewcomp, a spreadsheet program; Unify, a relational data-base-management program; and word processing with Finalword. The catalog covers specifications, printer support, commands and utilities, and other features of each package. Call Unisource Software Corp. at (617) 491-1264 for a copy or write to the company at 71 Bent St., Cambridge, Mass. 02141. [Circle 424]

Mil Spec. Over 9,000 devices are featured in the *Military Designer's Reference Guide*, a 100-page manual that contains four product sections: logic, linear and interface, bipolar memory, and MOS memory. There is also a section on the SBR9989 16-bit military processor, and product descriptions for advanced low-power Schottky and AS, CMOS, and LinCMOS are included. Other topics include a JM38510 cross reference to generic types and sections on packaging and leadless ceramic chip carriers for surface mounting. For a free copy, ask for Literature SGYZ001 from Texas Instruments Inc., Semiconductor Group, Literature Response Center (SC-466), P.O. Box 809066, Dallas, Texas 75240. The toll-free phone number is (800) 232-3200, ext. 700. [Circle 426]



Data communications. A free 148-page catalog of modems, multiplexers, protocol converters, test equipment, terminals, printers, backup power units and more—over 1,000 products in all—is available from Datalink Ready Inc. Each product listing carries a technical description and specifications. Two pages of testing notes preface the instruments section, and 30 pages of references and standards information are included. For more information, or to request a copy, call the company at (305) 676-0500 or write to P.O. Box 2169, Melbourne, Fla. 32902. [Circle 427]

Etching system. A bulletin and specification sheet on the models CS-514 and CS-515 cupric chloride etching systems is offered by Chemcut Corp., a subsidiary of West Germany's Schering AG. Both models include a regeneration system, conveyor, loading and unloading stations, etch station linked to etchant regenerator, and rinsing station. Model CS-515 adds a strip station. To request a free copy of this literature, call the manufacturer at (814) 238-0514 or write to their U.S. address: 500 Science Park, State College, Pa. 16803. [Circle 430]

Microelectronics overview. The fast-moving field of semiconductors is presented in a 60-page handbook titled *Welcome to Lilliput*, by Ronald A. Powell, associate director of Varian Research Center's Materials and Equipment Laboratory. The paperback highlights some of the problems the IC industry must overcome as it builds increasingly complex chips, focusing on defense and consumer electronics. Written for a general audience, the handbook comes free from Varian Associates Inc., Semiconductor Equipment Group, Box J-105, 611 Hansen Way, Palo Alto, Calif. 94303. The requests should be made on company letterhead. [Circle 425]

EMI. Entitled "Radiation Test Services: EMI Emission Problems . . . We Identify and Solve Them," this free brochure describes Chomerics Inc.'s test capability, including Federal Communications Commission testing to Part 15, Subpart J; VDE; Tempest; MIL-STD-461A/B; and shielding effectiveness from 14 kHz to 12.4 GHz. The company has tested computers, terminals, typesetting systems, disk drives, private branch exchanges, word processors, and printers. Verification testing or design and applications engineering are both available; for more information, call (617) 935-4850, ext. 355, or write to the company at 77 Dragon Ct., Woburn, Mass. 01888. [Circle 428]

SMD packaging. A system called μ-Bond for high-temperature, high-shock packaging of surface-mounted devices is described in a six-page brochure from Advanced Performance Technologies. The system has applications in such areas as oil-exploration electronics, military electronics, digital avionics, I/O controller and process-controller packaging, and prototyping, the manufacturer says. Its Teflon-insulated Nanowire has a dielectric constant (K factor) of 2.0, for circuit performance above 250 GHz. Request a copy of "μ-Bond Circuit Cards" from APT at 6725 Variel Ave., Canoga Park, Calif. 91303. Phone (818) 340-9251. [Circle 429]

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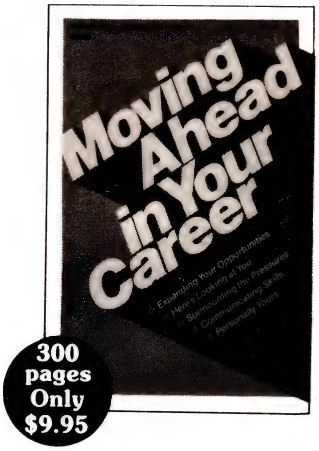

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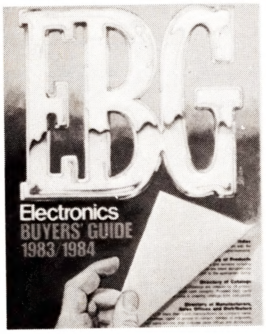

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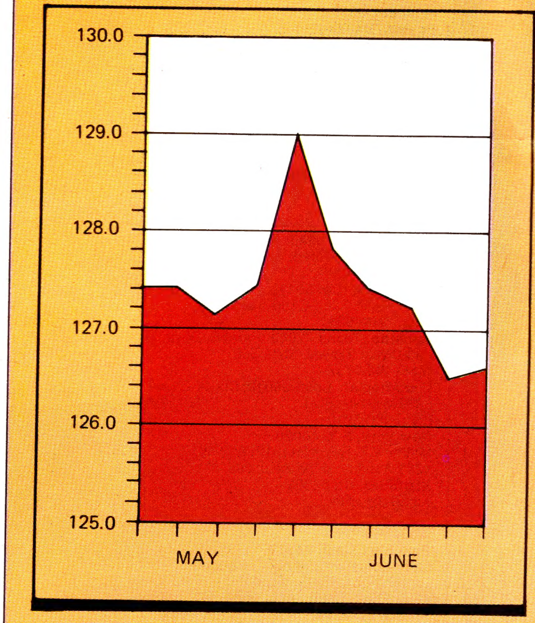

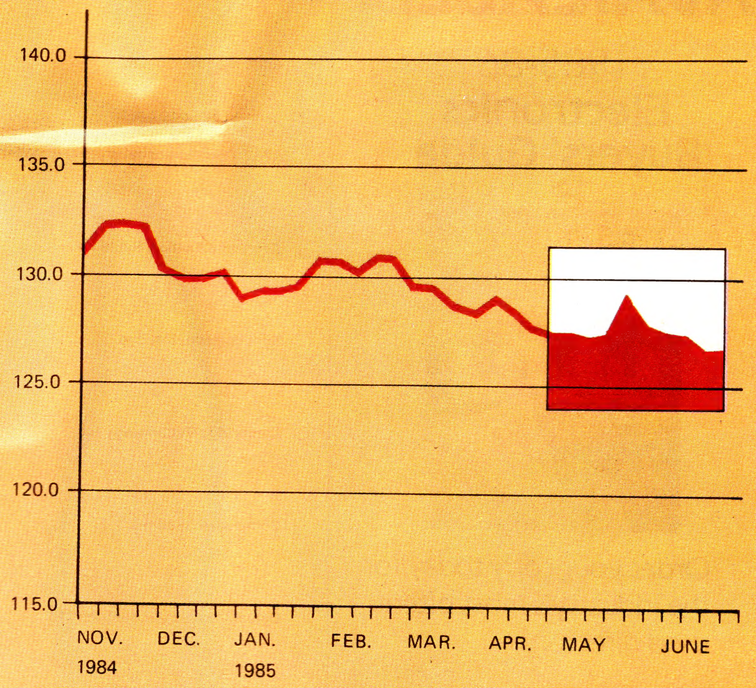

THIS WEEK = 126.6
LAST WEEK = 126.5
YEAR AGO = 126.6
1982 = 100.0

The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS COMPONENT-PRODUCER PRICE INDEX (1967=100)

	May 1985	April 1985	May 1984
Digital bipolar integrated circuits	59.8	60.0	63.2
Digital MOS ICs	39.8	40.4	42.9
Linear ICs	63.1	60.4	64.1
Capacitors	190.1	190.8	190.1
Resistors	188.7	188.5	181.8
Relays	312.6	312.6	319.1
Connectors	234.1	233.3	228.2

Slight gains in the prices of electronic components helped nudge the *Electronics* Index up slightly in the latest week. But after months of sagging sales and slipping production in the general electronics industry, the 0.2% rise in components prices in May was hardly enough to override the Index's severe declines over the past few weeks. (The Component-Producer Price Index is one of the factors used to compute the *Electronics* Index.) Hence, the Index now stands at precisely the same level as it did this time last year.

Overall electronics prices, according to the latest government data, were 0.1% lower than they were a year ago. Though the electronics industry's usual trip down the learning curve is responsible for part of the long-term decline in components' prices, the stultifying weakness in recent demand for components undoubtedly deserves some of the credit as well.

Prices for most types of components were flat or weaker in May (the latest month for which information is available), but there were product categories that experienced price increases. For example, prices of linear integrated circuits went up a whopping 4.5%. This jump was probably attributable to price disruptions because the item is still priced 1.6% lower than last year.

Connectors (which increased in price by 0.3%) and resistors (up 0.1%) were other electronics components that enjoyed less dramatic price gains.

On the down side, digital MOS chips, a major casualty in the semiconductor glut, suffered a 1.5% loss in pricing power in May. Digital bipolar IC prices fell 0.3% as well.

As major equipment manufacturers continue to close plants and lay off workers, and as imported components continue to outprice domestic wares in the marketplace, weak demand—not greater efficiency in component production—will probably contribute future price declines in the U.S. industry.

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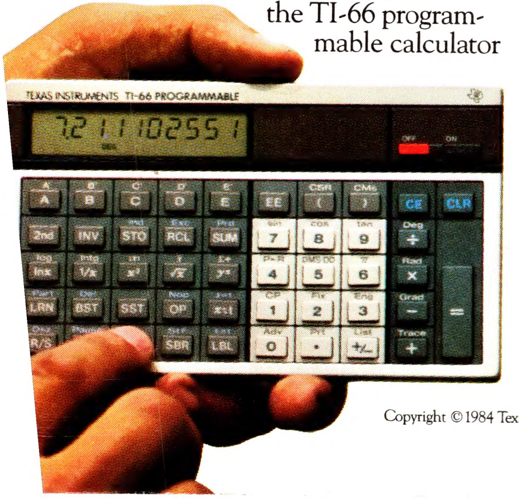

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